JOINT SERVICES

HANDBOOK OF LUBRICANTS

Temporary Protectives, Fuels and Miscellaneous Fluids

ADMIRALTY BOOK OF REFERENCE
No. B.R. 1336

SIXTH EDITION

LONDON
HER MAJESTY'S STATIONERY OFFICE
FIVE SHILLINGS NET

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Introduction

THIS Handbook is issued to provide in a convenient form concise information regarding the main properties and uses of Service lubricants fuels and related products.

The Joint Petroleum Products Sub-Committee (J.P.P.S.) is the organisation which advises on joint policy relating to Service lubricants and fuels. The Lubricants and Fuels Working Panels of J.P.P.S. consider the technical requirements for Service lubricants and fuels and draw up suitable Ministry of Defence specifications (DEF-0000). Comments from Industry and the British Standards Institution are considered before deciding the final details of these specifications.

Many Departmental specifications still exist and new ones will continue to be published for certain specialised products but the intention is that all materials which have a Joint-Service application shall be covered by Ministry of Defence specifications.

The J.P.P.S. and its Working Panels continue to carry out the policy of the war-time Inter-Service committee on Specifications by keeping the number of Service lubricants to the minimum required for efficient functioning of Service equipments.

Acknowledgment is gratefully made of the help of various branches of the Services, Ministry of Defence and Ministry of Aviation in keeping the information for this Handbook up to date. Corrections and comments will be appreciated.

The Handbook is arranged in six sections. The products in sections I to IV are in alphabetical and numerical order according to their Joint Service Designation (e.g. OM-100), the significance of which is explained on page vii. Certain descriptive names, now replaced by Joint Service Designations, are included in the general index. Section V (fuels) is arranged in groups depending on the uses for which the products are intended. Section VI is arranged in three groups (a) coolants and anti-freeze agents. (b) deicing and defrosting agents and (c) power augmentation fluids. Each group is in numerical order.

Specifications and Stores Numbers

The issuing authorities for the various specifications and stores numbers are listed on page x. The numbers and revisions quoted are those extant at the time of going to print but are subject to revision at any time.

The existence of two specification references for the same product indicates that there are two issuing authorities whose requirements in such matters as inspection may differ although their technical requirements are identical. It does not imply that there is more than one variety of the product. On the other hand, one specification may cover several closely related products.

Characteristics

Only the main physical and chemical characteristics of the materials are given; for fuller details the specifications should be consulted. Where applicable, tests results quoted are those obtained by using the Standard Methods of the Institute of Petroleum. However, many tests for which no I.P. method is available or suitable are described in detail in a series of loose leaf methods in a Ministry of Defence specification No. DEF-2000 entitled "Standard Methods for Testing Petroleum Oils and Lubricants (P.O.L.) and Allied Products". Where no standard method is available for a test called for by a specification it is described in detail in that specification.

Viscosities are unavoidably quoted in various units and at differing temperatures to accord with the specifications, but with the aid of the charts these can be compared approximately. The viscosity temperature charts following the last page show centistoke, Redwood No. 1 and Saybolt Universal viscosity scales.

Technical Terms and Abbreviations

The glossary on page xii is aimed at simplicity and brevity rather than strict precision and is meant merely to assist users unfamiliar with the subject. For scientifically exact information the appropriate text books should be consulted.

Alternatives

United States and Canadian alternatives are quoted and where these have been agreed as a result of international discussions the following agreed terms 1, 2 and 3 are used to indicate the degree of equivalence. Only in the case of standardised products can it be assumed that the products of all three countries are to all intents and purposes identical.

1. *Standardised Product*

Standardised products conform to the technical requirements of a common specification or have been designated as such by the appropriate standardising agency.

2. *Acceptable Product*

An acceptable product is one which can be used in place of another product for extended periods without technical advice.

3. *Emergency Substitute*

An emergency substitute is a product which may be used, in emergency only, in place of another product but only on the advice of a technically qualified person of the nation using the product, who will specify the limitations.

4. *Related Product*

In many cases the differences between the U.K. and the U.S. and Canadian products used for similar purposes are such that it has not been found possible to agree officially to the use of the latter even as emergency substitutes for the U.K. products. Nevertheless in this handbook in order that the reader may be able to find references to certain U.S. and Canadian products in the above category, which would otherwise not appear, their specification numbers have been quoted under the heading of related products. However, it cannot be over emphasized that in no circumstances may a related product be used in U.K. equipment to replace a standard one.

New and Obsolete Grades

It will be obvious that the introduction of new products to meet the needs of new equipment, etc., must be accompanied as far as possible by the elimination of older grades in order to avoid the difficulties created by an ever-increasing variety of supplies. The work of the Joint Petroleum Products Sub-Committee will be assisted by early information on impending changes.

Obsolete grades are no longer included. For their characteristics reference should be made to earlier editions of this Handbook. Grades which are in process of being replaced, but of which stocks still remain to be used up, are included among the current entries as "Obsolescent" without further details other than references to the grades which are replacing them.

Queries

Any queries arising in connection with the contents of this Handbook should be referred to:—

War Office D.G.F.V./F.V.A.3,
St. Christopher House,
Southwark Street,
LONDON, S.E.1.

Tel: WATerloo 7999 Ext. 4275 or 4276.

Designations and S.A.E. Numbers

DESIGNATIONS USED IN JOINT-SERVICE NOMENCLATURE

EACH designation or symbol in Sections I-IV and VI consists of two or three letters followed by a number. The significance of the letters is given below. In the case of oils the number indicates the approximate viscosity at 100°F. in centistokes. Thus OM-16 represents mineral oil of viscosity 16 cS. The lower the number the thinner the oil. In the case of greases the number indicates the approximate penetration determined by the Institute of Petroleum method i.e. the lower the number the stiffer the grease.

Fuels (Section V) have more varied designations, the letters giving some indication of the use for which the product is intended and the numbers some outstanding feature such as knock rating or freezing point e.g. AVTUR/50 represents aviation turbine fuel with a freezing point of minus 50°C.

Temporary Protectives, Specialities and miscellaneous fluids carry numbers unrelated to the characteristics of the product.

Section I Oils — *Pages*

OC – *Oil, Compounded.* A blend of mineral oil and fatty oil only . . . . . 1 and 2

OEP – *Oil, Extreme Pressure.* An oil containing additives which enable it to withstand extreme gear-tooth pressures . 3 to 6

OF – *Oil, Fatty.* A plain fatty oil or a fatty oil plus solvent . . . . . 7 to 9

OM – *Oil, Mineral.* A plain mineral oil or one containing additives intended to improve its behaviour as such (e.g. by a lowered pour point), without conferring radically different properties. Special permission to introduce such additives is sometimes given . . . . . 10 to 21

OMD – *Oil, Mineral, Detergent.* A heavy duty internal combustion engine oil containing detergent additives . . 22 to 26

OX – *Oil, Miscellaneous.* A synthetic oil or a mineral oil containing widely modifying additives not covered by the designations OC, OEP or OMD . . . . . 27 to 33

Section II Greases

LG – *Lime-base Grease.* A grease consisting primarily of lime-(calcium) soap and mineral oil . . . . . 34 to 36

Pages

XG – *Miscellaneous Grease.* A grease made from unspecified or less common soaps such as those of aluminium or lithium, or a grease containing graphite or other non-soap additions or fatty or synthetic oils . . . . . 36 to 47

Section III Specialities

ZX – *Speciality, Miscellaneous.* A material not included in the above classes . . . . . 48 to 55

Section IV Temporary Protectives

PX – *Protective, Miscellaneous.* A material used for temporary protection of metal equipment in storage. "Temporary" refers to the fact that the protective is easily removable and it has no implications regarding the length of time for which the material is effective as a protective . . 56 to 66

Section V Fuels

Products used as fuels in spark ignition, compression ignition and gas turbine engines and for steam raising and other heating purposes. . . . . 67 to 91

Section VI Miscellaneous Fluids

AL—A material used for engine power boost, anti-freeze, de-icing or cooling. 92 to 99

S.A.E. NUMBERS

S.A.E. numbers are issued by the American Society of Automotive Engineers and provide a broad classification of oils, on a basis of viscosity only, to supersede ambiguous descriptions such as light, medium and heavy.

Engine Oils

S.A.E. Number	*Viscosity (in round figures)*
5W	880 cS max. at 0°F
10W	1,300* to 2,600 cS at 0°F
20W	2,600† to 10,500 cS at 0°F
20	5·7 to 9·7 cS at 210°F
30	9·7 to 13 cS at 210°F
40	13 to 17 cS at 210°F
50	17 to 23 cS at 210°F

*waived if over 4·2 cS at 210°F
†waived if over 5·7 cS at 210° F

Gear Lubricants

S.A.E. Number	*Viscosity (in round figures)*
75	3,250 cS max. at 0°F
80	3,250 to 21,600 cS at 0°F
90	14 to 25 cS at 210°F
140	25 to 43 cS at 210°F
250	43 cS min. at 210°F

N.L.G.I. CLASSIFICATION

The N.L.G.I. numerical classification of greases is issued by the American National Lubricating Grease Institute. It indicates the consistency of greases in terms of their worked penetration of 77°F.

N.L.G.I. Number	*Worked penetration at 77°F*
0	355—385
1	310—340
2	265—295
3	220—250
4	175—205
5	130—160
6	85—115

Issuing Authorities

SPECIFICATIONS

WHERE more than one specification is quoted for the same product the technical requirements are identical. A revision is indicated by some authorities by a suffix letter, but the current validity of any specification can only be ascertained by consulting the issuing authority. Some specifications group two or more products under the same number.

Prefix to Number	*Issued by*
AN–	U.S. Army Air Force.
BS	British Standards Institution, 2 Park Street, London, W.1.
C.S.	Director of Chemical Inspection, War Office, H.Q. Building, Royal Arsenal, Woolwich, London, S.E. 18.
CSA	Canadian Standards Association, Ottawa.
DEF–	Ministry of Defence through H.M. Stationery Office, Kingsway, London, W.C.2.
DED D. Eng. R.D.	Directorate of Engine Research and Development, St. Giles Court, 1/13 St. Giles High Street, London, W.C.2.
D.T.D. *D.T.D. 900	Ministry of Aviation through H.M. Stationery Office, Kingsway, London, W.C.2.
E. in C.O–	Director General, Ships, Admiralty, Bath, through Director of Navy Contracts, Admiralty, London.
K.	Department of Weapons (Naval Ordnance Inspection Division), Admiralty, Bath, through Director of Navy Contracts, Admiralty, London.
MIL–	U.S. Military Specification. (Used by Armed Forces only).

*D.T.D. 900 specifies the conditions on which the Ministry of Aviation approves certain proprietary products and an appendix lists the manufacturers, trade names, approval numbers (e.g. D.T.D. 900/1234) and extent of approval of these products. No technical details are given.

Prefix to Number	*Issued by*
Schedule	Director of Naval Contracts, Admiralty, London.
T.E.E. T.F.	Originally issued by Superintendent, Torpedo Experimental Establishment, Greenock. Refer now to Admitralty Oil Laboratory, Great West Road, London.
T.S.	Director of Chemical Inspection (see C.S.).
VV–	U.S. Federal Specification.
3–GP– and 31–GP–	Canadian Government Specification Board.

STORES NUMBERS

Stores Reference	*Issued by*
AAC	Army Air Corps.
0442, 0462, 0474, 0475	Director of Stores, Admiralty.
HA or HI	Army Ordnance.
Patt	Director of Stores, Admiralty.
RASC	RASC supplies do not have Stores Numbers. The Joint Service Designation (e.g. OM–16 is employed).
34A/ ; 34B/ ; or 34D	Royal Air Force.
Joint Service Catalogue Number	Ministry of Defence.

Under each product in the Handbook there is a paragraph headed "Stores Numbers". This includes NATO Code No., Joint Service Catalogue No., Package size and the Stores Catalogue Numbers used by the three Services. If the product has no NATO Code No. or if one or more of the Services does not stock it, this is indicated by a – sign in the appropriate column. A + sign in a Service column indicates that the product is stocked by that Service but had not been allocated a Stores Catalogue Number at the time of going to press. It should also be noted that neither the RASC nor the AAC uses catalogue numbers.

Each Joint Service Catalogue Number represents a standard unit container as well as the product itself and there are as many numbers for a product as there are container sizes stocked. The entire range of sizes is not necessarily issued by each Service. Normal containers are: 40 or 45 gallon and 5 gallon drums, 4½ gallon jerricans, 2 gallon drums and one gallon, one quart and one pint cans or tins. In the case of smaller units the kind of container is mentioned, and where no size is stated it may be assumed that the system was not fully operative at the time of going to press. Where a Service stores number includes the end digits of the Joint Service Catalogue Number, it is an indication that the same package size applies; elsewhere the size is unspecified. The Joint Service Designation (e.g. OM–16) should not be confused with the Joint Service Catalogue Number (e.g. 9150–99–910–0599).

Technical Terms and Abbreviations

At the suggestion of users of the Handbook, explanations of technical terms are given below. These are not offered as scientifically exact definitions; they are meant merely to make the text somewhat more intelligible to those unfamiliar with the subject and, to that end, strict precision is sometimes sacrificed for the sake of simplicity and brevity. They are confined to meanings within the context of the Handbook. For exact definitions the appropriate textbooks should be consulted.

Additive. A substance added to a product in a small proportion to confer on it some desired characteristic.

Alcohol. A compound of carbon, hydrogen and oxygen in which each atom of oxygen is linked to one of carbon and one of hydrogen e.g. methanol and glycol.

Aniline point. Lowest temperature at which the substance is completely miscible with an equal volume of aniline. A high reading points to a low aromatic content and less effect on rubbers.

Anti-freeze agent. A substance added to water to reduce its freezing point, e.g. ethylene glycol, used in engine coolants and methanol in power boost fluids.

Anti-wear additive. A substance which by surface activity increases the resistance of lubricating films to disruption.

Aromatics. Hydrocarbons of ring structure having the smallest hydrogen to carbon ration.

Bleeding. Separation of oil from grease during storage.

Bromine number. The percentage of bromine capable of being absorbed by a product. It provides a measure of the amount of unsaturated material in a fuel and to some extent its storage stability.

Carbon residue (Ramsbottom). Percentage of carbon residue left when an oil is rapidly distilled up to a dull red heat (550°C) in absence of air.

Cetane number. The percentage of cetane in a mixture with alpha methyl naphthalene which exactly matches the ignition delay characteristics of a compression ignition engine fuel.

Channelling test. A deep groove cut in the (partly congealed) oil at the specified temperature must collapse to a given extent within a stated number of seconds.

Cold test. Used herein to mean the lowest temperature at which the substance will flow when observed under specified conditions not identical with those of the pour point test.

Colloidal suspension. A mixture of solid and liquid in which the solid is prevented from settling out by extremely fine dispersion and sometimes by the presence of a "deflocculating" agent.

Crackle test. Gives an indication of the presence of moisture by the crackling sound emitted when an oil is heated in a test tube.

Cloud point. Temperature at which a clear oil begins to "cloud" owing to separation of wax crystals, etc.

Centipoise. (abbrev. cP) Equals 0·01 poise, the metric unit of viscosity. When a liquid fills the space between two flat plates one of which is caused to slide over the other by a known force:—

$$\text{Viscosity of liquid (poises)} = \frac{\text{force (dynes)} \times \text{thickness of liquid film (cm.)}}{\text{rate of sliding (cm. per sec.)} \times \text{area of film (sq. cm.)}}$$

provided that the liquid wets (adheres to) both plates, and that turbulence does not occur in it. The viscosity of water at 20°C (68°F) is 1·005 centipoise.

Centistokes. (abbrev. cS) Equals 0·01 stokes, the metric unit of kinematic viscosity.

$$\text{Centistokes} \times \text{specific gravity} = \text{centipoises.}$$

The readings of gravity-flow viscometers (U-tube, Redwood, etc.) are convertible directly into centistokes.

cP. Centipoise.

cS. Centistokes.

Detergent Additive. A substance which when dissolved in lubricating oil reduces the adhesion between solid particles (e.g. of gummy or carbonaceous matter) and metals. Largely used to minimise persistent gumming of piston rings in heavy duty diesel engines. Most detergent additives confer a slight increase in load-carrying capacity but tend to promote oxidation. To counteract this, anti-oxident additives are usually incorporated also.

Diesel fuel. A petroleum product particularly suitable for use in compression ignition engines. Its viscosity and distillation range are generally intermediate between those of kerosine and light lubricating oil.

Diesel index. A figure indicating the ignition delay characteristics of a compression ignition engine fuel. It is a caluculated value obtained from some of the physical and chemical properties of the product as distinct from the cetane number which is determined in an engine.

Drop point. Temperature at which the first drop falls (from grease etc.), as melting begins.

Demulsification number. Time in seconds for separation of an emulsion of water and oil formed by injecting steam into the oil under prescribed conditions. Ranges from 30 to 1200 plus.

Dielectric Strength. A-C voltage required to initiate an arc between two electrodes, immersed in insulating oil or the like at a stated distance apart.

Emulsion. A dispersion of very small gobules of one liquid in another.

E.P. Extreme-pressure.

Esters. Manufactured compounds of alcohols and fatty acids which form the major constitutents of most synthetic lubricating oils.

Extreme-pressure Additive. An oil-soluble compound of sulphur, chlorine or other active element which releases that element at the very high temperature reached at points of incipient scuffing between the hardened steel surfaces of, for example, hypoid gears. The active element combines with iron and prevents the welding which otherwise would lead to tearing of the surfaces. Oils containing these additives are not suitable for indiscriminate use.

Fatty Oil. Oil of animal, fish or vegetable origin as distinct from mineral or synthetic oil.

Flash point. Lowest temperature at which a substance gives off enough vapour under stated conditions (using a closed or open vessel, etc.), to flash when a flame is applied. Flash point is in no way related to spontaneous ignition temperature, which is, for example, higher for petrol than for lubricating oil. The "closed" flash point is lower than the "open", usually by 20 or 30°F.

Flow point (Admiralty). The highest value for the pour point of a residual fuel oil than can be obtained when the sample has been heat treated at different temperatures in a prescribed range.

Freezing point. The temperature at which wax crystals begin to form in a fuel when it is cooled.

Gasoline (petrol). A refined petroleum distillate of high volatility, used in spark ignition engines, normally boiling within the range 30°C to 220°C.

Graphite. A form of carbon with a flaky structure and good lubricating properties.

Hard Asphalt. Asphaltic matter distinguished by insolubility in petroleum spirit. It is formed, with other substances, by oxidation of mineral oil.

Heat Stability. Resistance to permanent change resulting from heat alone.

Heavy Duty Oil. Oil containing detergent, anti-oxidant, etc., additives to render it suitable for heavy duty diesel engines.

Hertz Load. The "mean Hertz Load" specified is derived from a series of wear measurements at graded loads up to complete seizure, with an apparatus comprising four standard steel balls pressed together in pyramid form, the lower three being fixed whilst the upper one rotates against them.

Iodine value. The percentage of iodine that a product is capable of absorbing. It provides a measure of the unsaturated content of an oil and is an important criterion in the characterisation of fatty oils.

Lanolin. A substance removed from sheep's wool by scouring. It has useful anti-corrosion properties and is used in certain temporary protectives.

Kerosine. A refined petroleum distillate intermediate in volatility between gasoline and diesel fuel. Its distillation range is normally between 150°C and 300°C.

Knock rating. The detonation characteristics of a spark ignition engine fuel. See also octane and performance numbers.

Lead Scavenger. A compound usually ethylene dibromide or dichloride, added to spark ignition engine fuels, to remove the lead from the cylinders which would otherwise be left behind by the T.E.L. anti-knock agent.

Load-carrying additive. An anti-wear or extreme pressure additive.

Micro-crystalline wax. Wax, obtained from certain petroleum residues, which is without crystalline structure visible to the naked eye.

Mineral jelly. Petrolatum.

Molybdenum disulphide. A naturally occurring mineral with a flaky structure and good lubricating properties.

Motor method. (abbrev. M.M.). A term used to indicate the operating conditions used in the standard C.F.R. engine in the assessment of the knock rating of a gasoline. (See also research method).

Octane number. The percentage of iso-octane in a blend of iso-octane and normal heptane which exactly matches the detonation characteristics of a gasoline.

Optical density. Extant of ability to obstruct the passage of light.

Oxidation test. A test for susceptibility to attack by oxygen, by which acids, gum, and asphalt (in solution or as insoluble sludge) are formed.

Paraffins. Fully saturated hydrocarbon of the general formula C_nH_{2n+2}.

Penetration. The depth to which a standard inverted cone sinks under its own weight in a grease.

Performance number. A figure used to indicate the knock rating characteristics of aviation gasolines in the region above 100 octane.

Power boost fluid. A mixture of methanol and water introduced into an engine to increase its power output. In spark ignition engines it is fed into the eye of the blower and by its cooling effect it increases the volumetric efficiency of the engine and by reducing knock tendency, enables higher boost pressures to be used. In turbine engines it is introduced either into the intake or into the combustion zone. Its effect is to increase the mass flow through the engine.

Petrolatum, Mineral jelly or Petroleum jelly. A salve-like mixture of oil and microcrystalline wax obtained from petroleum.

Petroleum jelly. Petrolatum.

pH value. A measure of acidity or alkalinity in terms of the logarithm of the hydrogen ion concentration with the sign reversed pH 7=neutral, pH 0=extreme of acidity, pH 14=extreme of alkalinity.

Poise. See Centipoise.

Pour Point. The lowest temperature at which an oil moves visibly in a $1\frac{1}{4}''$ test tube held horizontally for 5 seconds. Oils can often be pumped at temperatures below pour point, but gravity flow into the pump may fail.

Pour point (lower). Determined after heating to dissolve any trace of wax and before it re-crystallizes.

Pour point depressant. An additive which lowers the pour point, generally by hindering crystallisation of traces of dissolved wax.

Redwood viscometer (No. 1). Measures viscosity in terms of the rate of emptying of a standard vessel with an aperture in the bottom. Stated in seconds required for 50 ml to discharge. The relationship between Redwood seconds and centistokes may be seen in the charts at the end of the Handbook.

R.S.2. Redwood No. 2 seconds.

Redwood viscometer (No. 2). Similar to No. 1 but allows about ten times as rapid flow, hence used for very viscous liquids.

Reid vapour pressure. (abbrev. R.V.P.). The vapour pressure of a fuel in pounds per square inch at 100°F measured in a standard apparatus. It provides a useful yardstick of ease of starting and of vapour locking tendency at high temperatures or high altitudes.

Research method (abbrev. R.M.). A term used to indicate the operating conditions used in the standard C.F.R. engine in the assessment of the knock rating of a gasoline. It is used for motor transport but not for aviation gasolines. The knock rating obtained by the R.M. is higher than that by the M.M. but there is no direct relationship between the two figures. (See also motor method).

Saybolt Universal viscometer. An American apparatus similar in principle to the Redwood. Equivalent readings can be obtained from the charts at the end of the handbook.

Shear breakdown. Breakdown of the molecules of a liquid into smaller molecules by the use of great force to overcome viscous resistance. It produces a permanent reduction of viscosity.

Shear stability. Resistance of a lubricant to shear breakdown.

Silicone Oils. Synthetic oils containing silicon and oxygen as well as carbon and hydrogen. Characterised by good resistance to heat and oxidation, high viscosity index and low pour point, but not fully equal to mineral oil as lubricants for steel on steel.

Sludge formation test. A test in which air or oxygen is bubbled through hot oil and the resulting asphaltic sludge is weighed.

Specific gravity. The ratio of the weight of a given volume of a substance to that of the same volume of water. Since the densities of water and other liquids vary with temperature by different amounts, the temperature should always be quoted. With fuels and oils it is customary to quote specific gravity at 60°F.

Stokes. See Centistokes.

Surface tension. The "skin effect" which causes liquids to gather into drops instead of spreading.

Synthetic lubricants. Lubricants built up by chemical processes.

Tetraethyl lead. (abbrev. T.E.L.). A liquid organic lead compound, of the formula $Pb(C_2H_5)_4$, added in small proportions to gasoline to improve knock rating.

V.I. Viscosity index.

Viscosity. Resistance to flow. Falls off on heating, see charts at the end of the handbook. Affects the thickness of oil films under load and the power absorbed by the oil in a mechanism.

Viscosity, absolute. Resistance to flow expressed in units of force (see Centipoise)—a scientific as distinct from an empirical expression in Redwood seconds or the like.

Viscosity, apparent (of lubricating grease). The viscosity expressed in poises calculated from measurements at a given rate of shear. The value varies with the shear rate.

Viscosity index. (abbrev. V.I.). A figure of merit, rating highest those products in which viscosity is least affected by change of temperature.

Viscosity index improvers. These are synthetic hydrocarbon products of enormously high viscosity, due to their large molecules. Oils made by thickening thin oils with viscosity index improvers have a better V.I. than oils of equal viscosity prepared normally. They are more susceptible than ordinary oils to shear breakdown.

Wide cut gasoline. (abbrev. AVTAG). A refined petroleum product with a wide distillation range used in aircraft turbine engines. Because of its wide distillation range a given quantity of crude oil will yield by straight distillation, a much larger quantity of it than of any other normal single product.

Worked penetration. A penetration reading taken on a grease immediately after it has been forced repeatedly through small holes in a plate. Some greases are more susceptible than others to softening by this procedure.

Section I. Oils

COMPOUNDED OILS

OC-35

Specification: C.S. 1250B

Composition:

Mineral lubricating oil	2 parts
Filtered sperm oil to B.S. 997	1 part

Characteristics:

Viscosity at 100°F	30–36 cS
Viscosity index, min.	85
Flash point, closed, min.	360°F (182°C)
Remains fluid and homogeneous at 0°C	(32°F)

Uses: Lubrication of artillery equipment, breech mechanisms.

Stores Numbers:

Nato Code No.	*Joint Service Catalogue No.*	*Package*	*Navy*	*Army*	*R.A.F.*
—	9150–99–910–0532	4½ gal	—	RASC	—

OC-160

Specification : DEF–2121

Composition:

Mineral oil	90%
Blown rapeseed oil	10% min.

Characteristics:

Viscosity at 100°F	155–165 cS
Pour point, max.	0°F (−18°C)
Flash point, open, min.	350°F (177°C)
Specific Gravity at 60°F, min.	0·935

The components must not separate during storage and the oil must pass a test for ability to hold water emulsified into it.

Uses: For external parts of reciprocating steam engines where emulsification with water is required. Elevating and training worm gears of gun mountings. Worm gears of certain 3·7″ A.A. guns. Heavy gearing in certain radar equipment.

Alternatives:

Standardised products

U.S. MIL–L–15019B (Military Symbol 4065)
Canadian 3–GP–376a

Stores Numbers:

Nato Code No.	*Joint Service Catalogue No.*	*Package*	*Navy*	*Army*	*R.A.F.*
	9150–99–942–3148	5 gal	—	RASC	34D/9423148
O–254	9150–99–910–0534	45 gal	K/9100534	—	—
	9150–99–943–7240	4½ gal	—	RASC	—

OC-300*

(Oil LPP)

Specification: T.E.E. 2F/12.

Composition:

Mineral oil	90%
Refined unblown rapeseed oil	10%

Certain additives are permitted.

Characteristics:

Viscosity at 70°F max.	1020 cS
„ „ 140°F	88–104 cS
„ „ 200°F min.	24 cS
Pour point max.	−10°F (−23°C)
Flash point, closed, min.	350°F

Use: Low pour point oil for 18 in. and 21 in. torpedoes and certain naval worm and reduction gears.

Stores Numbers:

Nato Code No.	*Joint Service Catalogue No.*	*Package*	*Navy*	*Army*	*R.A.F.*
—	9150-99-943-7238	5 gal	0475/9437238	—	—

*The designation OC-310 was at one time associated with this product.

OC-600

(Oil C600)

Specification: DEF-2122

Composition:

Mineral oil	94%
Rapeseed oil to B.S. 631	6%

Characteristics:

Viscosity at 210°F	29–32 cS (122–134 R.S.)
„ index, min.	80
Pour point, max.	30°F (−1°C)
Flash point, closed, min.	460°F (238°C)

Must remain fluid and homogeneous at 32°F. (0°C.)

Uses: Driving axles of certain British manufactured vehicles, including worm gear axles (Not suitable for hypoid axles). Gear-boxes (excepting pre-selector boxes) and chassis of certain vehicles, artillery carriages and mountings; tails of certain torpedoes; also for vane-type shock absorbers (obsolescent).

Alternatives:

Related products

For gear boxes: U.S. MIL-L-2104A Am. 1 Grade 50
Canadian 3-GP-395a
For rear axles: U.S. MIL-L-2105 (Grade 90)
Canadian 3-GP-390b

Stores Numbers:

Nato Code No.	*Joint Service Catalogue No.*	*Package*	*Navy*	*Army*	*R.A.F.*
O-208	9150-99-910-0536	4½ gal	0475/9100536	RASC	34D/9100536

OEP-14

Specification: C.S. 3108

Composition: Mineral oil containing an extreme pressure additive which has been approved for certain OEP-220 oils, but in 50% greater proportion.

Characteristics:

Viscosity at −65°F, max.	50,000 cS
„ „ 210°F, min.	3·0 cS
Channelling test, must pass at	−65°F (−54°C)
Pour point, max.	−65°F (−54°C)

Must have no deleterious effect on copper foil at 250°F. If the temperature of the oil in the gear casing exceeds 250°F, there is a risk that some decomposition of the EP additive may occur.

Uses: For hypoid gears in back axles of vehicles and as a general gear lubricant (but not for worm gears or marine use) under arctic conditions.

Alternatives:

Standardised products

Canadian 3-GP-336
U.S. MIL-L-10324A

Stores Numbers:

Nato Code No.	*Joint Service Catalogue No.*	*Package*	*Navy*	*Army*	*R.A.F.*
O-188	9150-99-910-0537	—	—	RASC	—

OEP-30

Specification: D.T.D. 581B Grade L

Composition: Mineral oil with extreme pressure additives.

Characteristics:

Flash point (open) °F	280 min.
Load carrying capacity (Mean Hertz load)	50 min.
Pour point °F	−40 max.
Viscosity cS at 100°F	23 min. 34 max.
Viscosity index	80 min.

Must pass tests for acidity and copper corrosion.

Use: In certain aircraft gear boxes.

Alternatives:

Standardised products

U.S. MIL-L-6086B Grade L
Canadian do

Stores Numbers:

Nato Code No.	*Joint Service Catalogue No.*	*Package*	*Navy*	*Army*	*R.A.F.*
O-153	9150-99-943-9815	5 gal	—	—	34B/9439815

OEP-38

Specification: C.S. 3000A (includes OEP–220)

Composition: Mineral oil containing an approved amount of an approved extreme pressure additive.

Characteristics:

Viscosity at 100°F	32–41 cS
Viscosity index, min.	85
Channelling test, must pass at	−50°F (−46°C)

Must pass a corrosion test on steel at 200°F in the presence of water and have no deleterious effect on copper foil at 250°F. If the temperature of the oil in the gear casing exceeds 250°F there is a risk that some decomposition of the EP additive may occur. Before approval an additive is subject to such functional tests as are deemed necessary to assure adequate performance under Service conditions.

Uses: For hypoid gears in back axles of vehicles and as a general gear lubricant (but not for worm gears or marine use) at low temperatures.

Alternatives:

Related products

U.S. MIL–L–2105 Grade 75
Canadian 3–GP–340a

Stores Numbers:

Nato Code No.	*Joint Service Catalogue No.*	*Package*	*Navy*	*Army*	*R.A.F.*
O–186	9150–99–910–0538	4½ gal	—	RASC	—

OEP-69

Specification: D.G.S. 6920.

Composition: A refined mineral oil with E.P. additives.

Characteristics:

Flash point, closed, °F	330 min.
Pour point, °F	10 max.
Sulphur corrosive (A.S.T.M. copper strip) at 130°C	2 max.
Sulphur corrosive (A.S.T.M. copper strip) at 100°C	1 max.
Viscosity cS at 210°F	8·2 min.
„ „ „ 32°F	1000 max.

Requirements include a salt water corrosion test.

Uses: For the following machinery in H.M. Ships where the gear tooth loading is such that oil OM–100 might not provide adequate lubrication. Main steam and gas turbines and associated gearing, auxiliary turbine installations, certain hydraulic equipment, general mechanical lubrication and air compressors.

Stores Numbers:

Nato Code No.	*Joint Service Catalogue No.*	*Package*	*Navy*	*Army*	*R.A.F.*
—	9150–99–220–2334	45 gal	K/2202334	—	—

OEP-70

(Extreme Pressure Gear Oil)

Specification: D.T.D. 581B Grade M.

Composition: A refined mineral oil containing an extreme pressure additive.

Characteristics:

Viscosity index, min.	80
,, at 100°F	60–82 cS
Pour point, max.	−20°F (−29°C)
Flash point, open, min.	310°F (154°C)
Load carrying capacity (Mean Hertz load), min.	50

Must pass tests for acidity and copper corrosion.

Uses: For translation unit bearings in contra-rotating propellers and in certain aircraft gear boxes.

Alternatives:

Standardised products

U.S. MIL–L–6086B Grade M
Canadian do

Stores Numbers:

Nato Code No.	*Joint Service Catalogue No.*	*Package*	*Navy*	*Army*	*R.A.F.*
O–155	9150–99–910–0539	5 gal	34B/9100539	—	34B/9100539

OEP-71

(Aviation Turbine Engine Oil)

Specification: D.E.D. 2479/1 Issue 2

Composition: Oil OM–71 containing an extreme pressure additive.

Use: In certain aircraft turbine engines.

Alternatives:

Emergency substitute

Canadian 3–GP–54J (OM–71) in turbo-jet engines only.

Stores Numbers:

Nato Code No.	*Joint Service Catalogue No.*	*Package*	*Navy*	*Army*	*R.A.F.*
O–136	9150–99–910–0540	5 gal	K/9100540	AAC	34A/9100540

OEP-90

OBSOLESCENT

Being replaced by OEP–69

OEP-220

Specification: C.S. 3000A (includes OEP–38).

Composition: Mineral oil containing an approved amount of an approved extreme pressure additive.

Characteristics:

Viscosity at 210°F	15·6–18·0 cS
,, index, min.	85
Channelling test, must pass at	0°F (−18°C)

Must pass performance tests in hypoid axles and a corrosion test on steel at 200°F in the presence of water. Must have no deleterious effect on copper foil at 250°F. If the temperature in the gear casing exceeds 250°F there is a risk that some decomposition of the EP additive may occur. Before approval an additive is subject to such functional tests as are deemed necessary to assure adequate performance under Service conditions.

Uses: For hypoid gears in back axles of vehicles and as a general gear lubricant at normal and tropical temperatures, but not for worm gears or marine equipment.

Alternatives:

Acceptable products

U.S. MIL–L–2105A (Grade 90)
Canadian 3–GP–390b (Grade 90)

Stores Numbers:

Nato Code No.	*Joint Service Catalogue No.*	*Package*	*Navy*	*Army*	*R.A.F.*
O–184	9150–99–910–0542	4½ gal	0475/9100542	RASC	34D/9100542

OEP-740

Specification: D.T.D. 900/4513

Composition: A gear oil with E.P. additives.

Characteristics: Viscosity within the S.A.E. 140 range, viz., 25–43 cS at 210°F.

Use: In gearboxes of certain helicopters. Not for normal hypoid applications.

Stores Numbers:

Nato Code No.	*Joint Service Catalogue No.*	*Package*	*Navy*	*Army*	*R.A.F.*
—	9150–99–942–8567	1 gal	—	—	34B/9428567

OF-3 (see OX-8)

Specification. C.S. 2906A (Includes OF–24)

Composition:

Castor oil	20% by wt.
2–Ethoxyethanol (Cellosolve)	80% by wt.
Potassium hydraoxide	Trace

Characteristics:

Viscosity at 70°F	4–6·5 cS
Viscosity at −22°F, max.	75 cS
Flash point Abel, min.	100°F (38°C)
Cloud point, max.	−40°F (40°C)
Pour point, max.	−50°F (−46°C)
pH value of aqueous emulsion	8·0–9·5

Uses: In brake systems and certain shock absorbers under arctic conditions. Is suitable for contact with natural rubbers.

Alternatives:

Related products

U.S. VV–F–451a
MIL–H–13910 (ORD)
Canadian 3–GP–510b

Stores Numbers:

Nato Code No.	*Joint Service Catalogue No.*	*Package*	*Navy*	*Army*	*R.A.F.*
—	9150–99–910–0564	1 gal	0442/9100564	—	—
	9150–99–943–3225	1 quart	—	RASC	—

OF-4

Specification: (Proprietary) D.T.D. 900/4081

Composition: A castor-oil-based hydraulic fluid.

Use: In main undercarriage shock absorbers of certain aircraft. R.A.F. and Naval Air use only.

Alternative:

Standardised product

Canadian D.T.D. 900/4081

Stores Numbers:

Nato Code No.	*Joint Service Catalogue No.*	*Package*	*Navy*	*Army*	*R.A.F.*
H–534	9150–99–910–0565	5 gal	(0442/9100565) (34B/9100565)	—	—

OF-24 (see OX-8)

Specification: C.S. 2906A (Includes OF–3)

Composition:

2–Ethoxyethanol (Cellosolve)	40% by wt.
Castor oil	60% by wt.
Potassium hydroxide	Trace

Characteristics:

Viscosity at 70°F	30–50 cS
Flash point, Abel, min.	100°F (38°C)
Cloud point, max.	−20°F (−29°C)
Pour point, max.	−30°F (−34°C)
pH value of aqueous emulsion	8·0–9·5

Uses: Brakes, shock absorbers and certain other hydraulic uses except under arctic conditions when OF–3 is used. Is suitable for contact with natural rubber.

Alternatives:

Acceptable products

U.S. VV–H–910

Canadian 3–GP–510c

Stores Numbers:

Nato Code No.	*Joint Service Catalogue No.*	*Package*	*Navy*	*Army*	*R.A.F.*
H–54	9150–99–910–0566	1 gal	0442/9100566	RASC	34D/9100566
	9150–99–943–3226	1 quart	—	RASC	34D/9433226

OF-35

(Fluid for Oleo Shock Absorber Struts)

Specification: D.T.D. 388.Am.1

Composition:

Castor oil (D.T.D. 71A)	2 parts
Iso-propyl alcohol (B.S. 1595)	1 part

Characteristics:

Viscosity at 100°F, min.	32 cS
Viscosity at 32°F, max.	330 cS
Cold test; must pass at	−32°C (−26°F)
Satisfactory for use with natural rubber.	

Use: For certain aircraft oleo legs.

Stores Numbers:

Nato Code No.	*Joint Service Catalogue No.*	*Package*	*Navy*	*Army*	*R.A.F.*
H–53a	9150–99–910–0567	1 gal	34B/9100567	—	34B/9100567

OF-285

Specification: Proprietary.

Composition: A modified castor oil.

Use: In worm gears of certain fighting vehicles.

Stores Numbers:

Nato Code No.	*Joint Service Catalogue No.*	*Package*	*Navy*	*Army*	*R.A.F.*
—	—	—	—	+	—

OF-300

Specification: D.T.D. 72.

Composition: Treated castor oil.

Uses: For B.T.H. air compressors in aircraft and oil seals.

Stores Numbers:

Nato Code No.	*Joint Service Catalogue No.*	*Package*	*Navy*	*Army*	*R.A.F.*
—	9150-99-910-0543	5 gal	34B/9100543	—	34B/9100543

OM-3

(*Fluid, Hydraulic, Extactor Control*)

Specification: D.T.D. 900/4361.

Composition: Mineral oil.

Characteristics:

Viscosity at 100°F, min.	4 cS
Pour point, max.	−50°F (−46°C)

Use: In extractor controls in submarines and certain aircraft control systems.

Stores Numbers:

Nato Code No.	*Joint Service Catalogue No.*	*Package*	*Navy*	*Army*	*R.A.F.*
—	9150-99-910-0569	1 quart	34B/9100569	AAC	34B/9100569
	9150-99-943-1323	5 gal	0475/9431323	—	—

OM-11

(*Aviation Turbine Oil*)

Specification: D.Eng. R.D. 2490 Am.1.

Composition: A light mineral oil of low pour point containing 0·05 to 0·10% stearic acid.

Characteristics:

Viscosity at 100°F, min.	13 cS
Viscosity at −15°F, max.	1250 cS
Pour point., max.	−50°F (−46°C)
Flash point, min.	290°F (143°C)
Aniline point, min.	85°C (185°F)
Aniline point, change on treatment with sulphuric acid, max.	5·5°C (9·9°F)

The specification includes a test for oxidation resistance, otherwise it is identical with that for OM-13.

Use: Lubrication of certain early marks of aircraft turbo-jet engines. e.g. Avon I.
Alternative:

Emergency substitute

Canadian 3-GP-38a

Stores Numbers:

Nato Code No.	*Joint Service Catalogue No.*	*Package*	*Navy*	*Army*	*R.A.F.*
O-135	9150-99-910-5055	5 gal	K/9105055	—	34A/9105055

OM-12

Specification: D.T.D. 900/4205.

Composition: A light mineral oil containing corrosion and oxidation inhibitors.

Characteristics:

Viscosity at 100°F min.	10 cS
Viscosity at −40°F max.	4000 cS
Pour point, max.	−70°F (−57°C)
Flash point, (closed) min.	265°F (129°C)

Use: Low temperature lubricant for certain aircraft flying control mechanisms.

Alternatives:

Standardised products
U.S. MIL-L-7870A
Canadian 3-GP-335a

Stores Numbers:

Nato Code No.	*Joint Service Catalogue No.*	*Package*	*Navy*	*Army*	*R.A.F.*
O-142	9150-99-943-8712	1 quart	—	—	34B/9438712

OM-13

Specification: DEF-2001-A.

Composition: A light mineral oil of low pour point, containing 0·05 to 0·10% stearic acid.

Characteristics:

Viscosity at 100°F min.	13 cS
Viscosity at 15° F max.	1250 cS
Pour point, max.	−50°F (−46°C)
Flash point, closed, min.	290°F (143°C)
Aniline point, min.	85°C (185°F)
Aniline point, change after extraction with sulphuric acid, max.	5·5°C (9·9°F)

Uses: Gun mounting recoil systems; shock absorbers of vehicles (where oil-resistant synthetic rubber glands are used); hydraulic couplings; hydraulic medium particularly at low temperatures; high speed spindles; air compressors at low temperatures; clocks, fire-control and similar instruments (except where OM-42 or OX-10 is specifically required); automatic and machine guns and small arms at low temperature; lubrication of aircraft armament and submarine torpedo tube fittings.

Alternatives:

Standardised product
Canadian 3-GP-38a
Emergency substitute
U.S. MIL-L-7870A

Stores Numbers:

Nato Code No.	*Joint Service Catalogue No.*	*Package*	*Navy*	*Army*	*R.A.F.*
O-134	9150-99-910-0570	4½ gal	—	RASC	34D/9100570
	9150-99-943-1324	5 gal	0475/9431324	—	—

OM-14

(Dashpot Hydraulic Fluid)

Specification: D.T.D. 548.

Composition: A refined petroleum distillate containing an approved thickening agent.

Characteristics:

Viscosity at 100°F, min.	13cS
Viscosity at 32°F, max.	48 cS
Viscosity at −22°F, max.	250 cS
Flash point, closed, min.	140°F (60°C)
Cold test, must pass at	−36°F (−38°C)

Use: In bomb sight dashpots.

Stores Numbers:

Nato Code No.	*Joint Service Catalogue No.*	*Package*	*Navy*	*Army*	*R.A.F.*
—	9150-99-910-0571	10 oz. bottle	—	—	34B/9100571

OM-15

(Hydraulic Oil—Petroleum Base)

Specification: D.T.D. 585 Am. 1 and 2.

Composition: A low viscosity, low pour point oil blended with an oxidation inhibitor, not more than 10% of a viscosity index improver and 0·5% tricresyl phosphate as an anti-wear agent.

Characteristics:

Viscosity at 130°F, min.	10 cS
Viscosity at −40°F, max.	500 cS
Pour point, max.	−75°F (−59°C)
Flash point, open, min.	200°F (93°C)

The specification includes corrosion tests on copper, cadmium, steel, also magnesium and aluminium alloys; evaporation and resistance to shear breakdown tests, and swelling tests on a standard rubber.

Uses: For hydraulic mechanisms in aircraft, naval machine guns 20 mm. and less as specified. Liquid springs in certain artillery equipment and predictors. Alternative to diluted OM-13 in gun buffers at arctic temperatures. Torpedo gear pumps.

Alternatives:

Standardised products

U.S. MIL-H-5606A

Canadian 3-GP-26a Am. 2

Stores Numbers:

Nato Code No.	*Joint Service Catalogue No.*	*Package*	*Navy*	*Army*	*R.A.F.*
H-515	9150-99-910-0572	1 gal	34B/9100572	RASC	34B/9100572
	9150-99-220-2291	45 gal	—	—	34B/2202291

OM-16

Specification: B.S. 148.

Composition: Highly refined mineral oil, specially prepared for use as an insulating oil.

Characteristics:

Viscosity at 70°F, max.	37 cS
Di-electric strength, 4 mm gap, min. ...	40,000 volts
Free moisture (crackle test on heating)	Nil
Pour point, max.	−25°F (−32°C)
Flash point, min.	295°F (146°C)
Sludge formation, max.	1·10%
Acidity development in sludge test, mg KOH/g max.	2·5
Evaporation loss (5 hrs. at 110°C) max.	1·6%
Copper discoloration (3 hrs. at 100°C)	Nil

Uses: In transformers, switchgear and for other electrical purposes.

Alternatives:

Standardised product	*Related product*
Canadian CSA–050–56	U.S. VV–O–401

Stores Numbers:

Nato Code No.	*Joint Service Catalogue No.*	*Package*	*Navy*	*Army*	*R.A.F.*
S–756	9160–99–942–7822	1 gal	0475/9427822	RASC	34D/9427822
	9160–99–942–7823	5 gal	0475/9427823	—	—
	9160–99–942–7824	10 gal	0475/9427824	—	—
	4160–99–942–7825	40/45 gal	0475/9427825	—	—

OM-17

Specification: C.S. 1496A.

Composition: A water-white, tasteless and odourless mineral oil.

Characteristics:

Viscosity at 70°F	27 to 37 cS
Pour point, max.	0°F (−18°C)
Flash point, closed, min.	310°F (155°C)
Iodine value, max.	1·0

The specification includes a test for optical density.

Uses: Lubrication of bakery and canteen equipment and preservation of bakery woodware.

Alternatives:

Related products

U.S. Petrolatum liquid light, U.S.P.
Canadian 3–GP–46
Medicinal paraffin, B.P.

Stores Numbers:

Nato Code No.	*Joint Service Catalogue No.*	*Package*	*Navy*	*Army*	*R.A.F.*
—	9150–99–910–0545	5 gal	—	RASC	—

OM-21

Specification: DEF–2002. Am. 1

Composition: A plain mineral oil.

Characteristics:

Viscosity at 100°F	16–24 cS
Flash point, closed, min.	149°C (300°F)
Pour point, max.	0°F (−18°C)

Use: Flushing of oil systems of piston aero-engines and gear boxes. OM–21 diluted with kerosine is used as a penetrating oil.

Stores Numbers:

Nato Code No.	*Joint Service Catalogue No.*	*Package*	*Navy*	*Army*	*R.A.F.*
—	9150–99–910–0563	4½ gal	0475/9100563	—	34D/9100563

OM-22

Specification: D.T.D. 900/4695.

Composition: Highly refined mineral oil, specially prepared for use as an insulating oil.

Characteristics: Identical with OM–16 (specification B.S. 148) except for Pour point which is 13°C lower, i.e. −45°C.

Uses: In transformers, switchgear and for other electrical purposes where specially low temperatures may be encountered.

Alternatives:

Related products

U.S. VV–O–401
Canadian CSA–050–56

Stores Numbers:

Nato Code No.	*Joint Service Catalogue No.*	*Package*	*Navy*	*Army*	*R.A.F.*
—	9160–99–944–0604	1 gal	K/9440604	—	34B/9440604

OM-33

Specification: DEF–2007.

Composition: A refined mineral oil compounded if necessary with approved anti-oxidant, anti-corrosion and anti-foam agents. The oil contains 0·5% by weight tricresyl phosphate (an anti-wear agent). Viscosity index improvers are not permitted but an approved pour point depressant may be used up to a maximum of 1·0%.

Characteristics:

Viscosity at −15°F, max.	6,000 cS
Viscosity at 100°F	28 to 35 cS
Cloud point, max.	−20°F (−29°C)
Flash point, min.	345°F (174°C)

The specification includes tests for acidity, oxidation stability, corrosion and foaming.

Uses: General use as hydraulic fluid on machine tools, fork-lift truck, etc., also on certain servo mechanisms and oil operated gunnery equipment. Lubrication of certain fire-control instruments, radar equipments and air compressors.

Alternative:

Related product

U.S. MIL–H–13919

Stores Numbers:

Nato Code No.	*Joint Service Catalogue No.*	*Package*	*Navy*	*Army*	*R.A.F.*
H–576	9150–99–942–3224	1 gal	0475/9423224	RASC	34D/9423224
	9150–99–910–0573	4½ gal	—	RASC	—
	9150–99–943–1325	5 gal	0475/9431325	—	—
	9150–99–944–0596	45 gal	0475/9440596	—	—

OM-36

Specification: E.-in-C. 0–9.

Composition: A plain mineral oil of low pour point.

Characteristics:

Viscosity at 70°F, max.	99 cS (410 R.S.)
Viscosity at 140°F	12·5–15·5 cS (59–69 R.S.)
pour point, max.	−34°C (−30°F)
Flash point, min.	325°F (163°C)
Oxidation Test; viscosity ratio, max. ...	2·0 (at 10 litres/hour air flow)

Use: In certain naval refrigerating plant only. Replaced by OM–70 for all other refrigerators and by OM–33 for other applications.

Stores Numbers:

Nato Code No.	*Joint Service Catalogue No.*	*Package*	*Navy*	*Army*	*R.A.F.*
O–288	9150–99–943–1328	5 gal	0475/9431328	—	—

OM-41

Specification: C.S. 2902.

Composition: A plain mineral oil.

Characteristics:

Viscosity at 100°F	40–50 cS
Flashpoint, closed, min.	325°F

Use: A component of OX–52.

Stores Numbers: None.

OM-42

(*Oil R.*304)

Specification: None. A proprietary oil.

Composition: Refined white mineral oil.

Use: Lubrication of magslips only.

Stores Numbers:

Nato Code No.	*Joint Service Catalogue No.*	*Package*	*Navy*	*Army*	*R.A.F.*
—	9150–99–910–0548	2 oz bottle	0475/9100548	RASC	—

OM-58

Specification: DEF–2004–A (Includes OM–160).

Composition: A plain mineral oil.

Characteristics:

Viscosity at 100°F	55 to 65 cS
Viscosity index, min.	75
Pour point, max.	0°F (−18°C)
Flash point, open, min.	370°F (188°C)

The specification includes tests for acidity and copper corrosion and limits the increase in viscosity and carbon residue produced by oxidation.

Uses: For air compressors and miscellaneous lubrication and hydraulic purposes. Also for small arms and machine guns (other than in aircraft) at medium ambient ground temperatures.

Stores Numbers:

Nato Code No.	*Joint Service Catalogue No.*	*Package*	*Navy*	*Army*	*R.A.F.*
—	9150–99–910–6165	4½ gal	0475/9106165	RASC	34D/9106165

OM-65

Specification: E.-in-C. 0–2.

Composition: A refined mineral oil.

Characteristics:

Viscosity at 100°F	62–68 cS
Viscosity index, min.	95
Pour point, max.	15°F (−9·5°C)
Flash point (closed), min.	380°F (193°C)

Uses: In naval gun mountings and submarines telemotering systems at medium and low ambient temperatures, 5·25 A.A. guns and for a number of miscellaneous purposes.

Alternatives:

Standardised product	*Emergency substitute*
Canadian 3–GP–52	U.S. MIL–15017, Military Symbol 211OH

Stores Numbers:

Nato Code No.	*Joint Service Catalogue No.*	*Package*	*Navy*	*Army*	*R.A.F.*
H–572	9150–99–910–0576	45 gal	K/910576	RASC	—
	9150–99–943–3223	4½ gal	—	RASC	—

OM-70

Specification: DEF–2006.

Composition: A refined mineral oil.

Characteristics:

Viscosity at 100°F	55–80 cS
Viscosity index, max.	50
Pour point, max.	−15°F (−26°C)

The specification includes tests for oxidation, asphaltene content, copper corrosion and moisture (crackle test). The maximum viscosity index limit is designed to exclude oils incompletely soluble in Freon at low temperatures. To protect the oil from contamination, especially by moisture, sealed containers are specified. Oil left in an opened container should be discarded.

Use: In all Service refrigerators except certain naval units.

Stores Numbers:

Nato Code No.	*Joint Service Catalogue No.*	*Package*	*Navy*	*Army*	*R.A.F.*
O–289	9150–99–942–4988	1 pint	0475/9424988	RASC	34D/9424988
	9150–99–942–4990	1 quart	0475/9424990	—	—
	9150–99–942–4989	1 gal	—	RASC	34D/9424989

OM-71

Specification: DED. 2479/0 Issue 2.

Composition: A refined mineral oil.

Characteristics:

Viscosity at 210°F	8·7–9·3 cS
„ index, min.	105
Pour point, max.	−20°F (−29°C)
Flash point, open, min.	410°F (210°C)

Uses: For certain British artillery of U.S. pattern, oxygen producing plant and miscellaneous aircraft applications.

Alternatives:

Standardised product	*Related product*
Canadian 3–GP–54J	U.S. MIL–H–13866 (ORD) when used as a recoil oil.

Stores Numbers:

Nato Code No.	*Joint Service Catalogue No.*	*Package*	*Navy*	*Army*	*R.A.F.*
O–138	9150–99–943–3224	4½ gal	0475/9433224	RASC	34D/9433224
	9150–99–910–0577	1 pint	0475/9100577	RASC	34D/9100577

OM-100

Specification: E.-in-C. 0–3.

Composition: A refined mineral oil which may contain corrosion and oxidation inhibiting additives.

Characteristics:

Viscosity at 100°F	82–92 cS
Viscosity at 210°F, min.	8·2 cS
Viscosity index, min.	50
Pour point, max.	20°F (−6·5°C)
Flash point, closed, min.	300°F (149°C)
Demulsification number, max.	300

The oil must show no corrosion in a copper strip test; must pass a foaming test, a 24-hour salt-water corrosion test at 140°F on steel after washing the oil with water, and an oxidation test (I.P. method 114/53P).

Oils supplied to this specification must also be compatible with all other oils previously supplied to this specification.

Uses: In steam turbines (main and auxiliary) and their associated gearing and in auxiliary reciprocating engines with forced lubrication systems, for ball and roller bearings in certain electric motors, for torpedo tube mechanisms and preservation of naval aircraft guns and belt feed mechanisms also in moderate duty sleeve bearings and for certain hydraulic and miscellaneous purposes in H.M. Ships.

Alternatives:

Standardised product	*Acceptable product*
Canadian 3–GP–357Ta	U.S. Military Symbol 2190 TEP to MIL–L–17331A (Ships) Am.1

Stores Numbers:

Nato Code No.	*Joint Service Catalogue No.*	*Package*	*Navy*	*Army*	*R.A.F.*
O–240	9150–99–944–0425	4½ gal	—	RASC	—
	9150–99–910–0578	45 gal	K/9100578	RASC	—

OM-150

(Oil, Anti-freezing, Type 417A)

Specification: D.T.D. 417A.

Composition: A low pour point mineral oil containing an approved thickening agent.

Characteristics:

Viscosity at 20°C (68°F)	...	...	350–2000 cS
Viscosity at 60°C (140°F), min.		...	50 cS
Passes ball and socket torque test at		...	−55°C (−67°F)

Uses: On hinges and open bearings in flying control systems where grease cannot be applied, for W/T aerial gear and for A/S fuzes.

Stores Numbers.

Nato Code No.	*Joint Service Catalogue No.*	*Package*	*Navy*	*Army*	*R.A.F.*
O-140	9150-99-910-0550	5 gal	34B/9100550	AAC	34B/9100550

OM-160

Specification: DEF-2004-A (Includes OM-58).

Composition: A plain mineral oil.

Characteristics:

Viscosity at 100°F	...	...	155–165 cS
„ index, min.	...	...	75
Pour point, max. ...	...	...	10°F (−12°C)
Flash point, open, min. ...	...	...	390°F (199°C)

The specification includes tests for acidity, copper corrosion and oxidation.

Uses: Air compressors, mechanisms of some locomotives. General lubrication purposes.

Stores Numbers:

Nato Code No.	*Joint Service Catalogue No.*	*Package*	*Navy*	*Army*	*R.A.F.*
—	9150-99-910-0551	4½ gal	—	RASC	—

OM-170

OBSOLESCENT

Being replaced by OM-270

OM-270

(Aero Piston Engine Oil Grade B/O)

Specification: D.Eng.R.D. 2472 Issue No. 2 Grade B/O.

Composition: A plain mineral oil.

Characteristics:

Viscosity at 210°F	...	...	...	18·80–21·15 cS
„ index, min.	...	...	...	95
Pour point, max. ...	...	...	...	10°F (−12°C)
Flash point, open, min. ...	...	...	...	470°F (243°C)

Type Test. The oil must satisfactorily pass an engine test under conditions approved by the Ministry of Aviation (Eng. R.D. 6). A list of approved oils is given in APL–2472.

Uses: Lubrication of liquid cooled and some air cooled aircraft piston engines; Packard engines of marine craft.

Alternatives:

Standardised products

U.S. MIL–L–6082B Grade 1100
Canadian 3–GP–100b Am. 1

Stores Numbers:

Nato Code No.	*Joint Service Catalogue No.*	*Package*	*Navy*	*Army*	*R.A.F.*
O–117	9150–99–910–0554	45 gal	K/9100554	AAC	34A/9100554

OM-490

Specification: None. A proprietary product.

Composition: A mineral oil.

Characteristics:

Viscosity at 140°F	...	...	...	About 600 R.S. (150 cS)

Good resistance to gumming and oxidation.

Use: Lubrication of Admiralty gyro-compass bearings.

Stores Numbers:

Nato Code No.	*Joint Service Catalogue No.*	*Package*	*Navy*	*Army*	*R.A.F.*
—	9150–99–910–0555	8 oz. bottles	0475/9100555	—	—

OM-750

Specification: DEF–2003, (Includes OM–1300).

Composition: A plain mineral oil.

Characteristics:

Viscosity at 210°F	28–35 cS
,, index, min.	70
Lower pour point, max.	35°F (2°C)
Flash point, open, min.	490°F (254°C)
Carbon residue (Ramsbottom) max. ...	2·0%
Asphaltenes, max.	0·1%

Uses: Lubrication of steam cylinders (saturated steam), up to 175 lb/sq. in., oxygen plants, firing gear of torpedo tubes, and certain ram gland packings.

Alternatives:

Acceptable products

U.S. MIL–L–15018A Military Symbol 5150 Am. 2
Canadian 3–GP–150a Type 1

Stores Numbers:

Nato Code No.	*Joint Service Catalogue No.*	*Package*	*Navy*	*Army*	*R.A.F.*
O–256	9150–99–943–3220	4½ gal	—	RASC	34D/9433220
	9150–99–910–0556	45 gal	K/9100556	RASC	34D/9100556

OM-1300

Specification: DEF–2003. (Includes OM–750).

Composition: A plain mineral oil.

Characteristics:

Viscosity at 210°F	38–48 cS
,, index, min.	70
Lower pour point, max.	35°F (2°C)
Flash point, open, min.	525°F (274°C)
Carbon residue (Ramsbottom), max. ...	2·5%
Asphaltenes, max.	0·1%

Uses: Lubrication of cylinders of steam operating on saturated steam above 175 lbs/sq. in. and on super-heated steam at all pressures.

Alternatives:

Acceptable products

U.S. MIL–L–15018A Military Symbol 5190
Canadian 3–GP–150a Type 2

Stores Numbers:

Nato Code No.	*Joint Service Catalogue No.*	*Package*	*Navy*	*Army*	*R.A.F.*
O–260	9150–99–910–0557	4½ gal	—	RASC	34D/9100557
	9150–99–943–1329	5 gal	0475/943/1329	—	—

Note on the DEF–2101B range of detergent oils for Ground and Marine Engines, viz:

OMD-30, OMD-40, OMD-110 and OMD-330

These oils are heavy-duty oils containing "detergent" additives which reduce the tendency to ring-sticking, scraper-ring plugging and carbon deposition, making them suitable for highly-rated diesel engines. They are also generally used in the Services for gasoline engines for which they offer advantages over plain mineral oils. There are certain general purpose uses where no benefit will be derived from the additives present in these oils and when this is the case plain mineral oils such as OM–33, OM–58 and OM–160 are to be preferred. Under wet conditions some heavy-duty engine oils can form emulsions which may block oilways.

The specifications include engine tests designed to determine the ring-sticking, bearing corrosion, oxidation and detergent properties and govern foaming characteristics and compatibility with other approved supplies.

When a detergent oil replaces a non-detergent oil, change-over instructions must be strictly observed; otherwise there is a danger of oil lines and filters becoming obstructed by solid matter released by the marked loosening action of these oils on deposits formed from the non-detergent oil.

The dispersant action of the detergent additives on fine particles of carbon leads to such oils becoming darker in use much more rapidly than plain mineral oils. It is important to note that this does not represent rapid deterioration of the oil, but it may lead to more rapid clogging of certain engine filters.

The extrapolated viscosity limits quoted for 0°F are taken from the specifications. By similar extrapolation from graphs the approximate temperature at which the oil of the poorest low-temperature properties allowed by the specification would be expected to reach a viscosity of 6,000 cS has been ascertained and this temperature is quoted because it is generally considered that engines should be capable of starting when the oil viscosity is 6,000 cS.

OMD-30

A Brtish oil which has been developed to replace OMD–29

Specification: C.S. 2994.

Composition: A refined mineral oil with additive(s).

Characteristics:

Viscosity at 210°F, min.	5·0 cS
„ „ −40°F, max.	8500 cS
Pour point, max.	−65°F (−54°C)
Flash point, open, min.	290°F (143°C)

Meets engine test and other requirements indicated in the note on page 22.

Use: For ground water-cooled I.C. engines at very low ambient temperatures (0°F to −65°F).

Alternatives:

Standardised products

U.S. MIL–L–10295A
Canadian 3–GP–343

Stores Numbers:

Nato Code No.	*Joint Service Catalogue No.*	*Package*	*Navy*	*Army*	*R.A.F.*
O–183	9150–99–943–7978	4½ gal	—	RASC	—

OMD-40

Specification: DEF–2101–B Am. 1 (Includes OMD–110 and 330).

Composition: A refined mineral oil with additives.

Characteristics:

Viscosity at 210°F	5·5–7·3 cS (S.A.E. 10)
„ „ 0°F (extrapolated from values at 210°F and 100°F), max. ...	2600 cS
Pour point, max.	−20°F (−29°C)
Flash point, open, min.	360°F (182°C)
Approximate temperature for viscosity 6000 cS	−10°F (−23°C)

Meets engine test and other requirements indicated in the note on page 22.

Uses: Lubrication of water-cooled compression-ignition and spark-ignition engines and in certain cases gear-boxes especially in severe winter conditions down to about 0°F. When used after a non-detergent oil for engine lubrication change-over instructions must be strictly observed.

Alternatives:

Standardised products

U.S. MIL–L–2104A Am. 1. Grade 10
Canadian 3–GP–345a. Am. 2

Stores Numbers:

Nato Code No.	*Joint Service Catalogue No.*	*Package*	*Navy*	*Army*	*R.A.F.*
O–176	9150–99–910–0579	5 gal	—	RASC	34D/9100579
	9150–99–943–7239	4½ gal	—	RASC	

OMD-60

OBSOLESCENT

Being replaced by OMD–40 and OMD–110 as appropriate.

OMD-110

Specification: DEF–2101–B. Am. 1 (Includes OMD–40 and 330).

Composition: A refined mineral oil with additives.

Characteristics:

Viscosity at 210°F	9·7–13·0 cS (S.A.E. 30).
„ „ 0°F (extrapolated from values at 210°F and 100°F), max.	43,000 cS
Pour point, max.	0°F (−18°C)
Flash point, open, min.	390°F (199°C)
Approximate temperature for viscosity of 6,000 cS	25°F (−4°C)

Meets engine test and other requirements indicated in the note on page 22.

Uses: Lubrication of most water-cooled and certain air-cooled compression-ignition and spark-ignition ground engines in temperate conditions. Also of certain gear-boxes and torpedo tube mechanisms. When first adopted for engine lubrication change-over instructions must be strictly observed. In certain applications using a 1% sulphur fuel, oil drainage periods may need to be shorter than if a higher additive oil such as OMD–112 were used. OMD–112 is not in RASC supply.

Alternatives:

Standardised products

U.S. MIL–L–2104A Am. 1 Grade 30
Canadian 3–GP–365a

Stores Numbers:

Nato Code No.	*Joint Service Catalogue No.*	*Package*	*Navy*	*Army*	*R.A.F.*
O–180	9150–99–910–0581	40 gal	—	RASC	34D/9100581
	9150–99–943–3219	4½ gal	—	RASC	—

OMD-112

Specification: E.-in-C. 0–5.

Composition: A refined mineral oil with additives.

Characteristics:

Viscosity at 210°F	11·9 to 13·5 cS
„ „ 0°F (extrapolated from values at 210°F and 100°F) max. ...	33,000 cS
Pour point, max.	0°F (−18°C)
Flash point, open, min.	390°F (199°C)

Meets engine test and other requirements similar to, but somewhat more exacting than, those laid down for OMD–110.

Uses: As a heavy duty crankcase oil for naval I.C. engines. In main and auxiliary engines, in craft fitted with Deltic main engines, also in Hercules DIX-6D engines in use with G.C.A. Type AN/C.P.N. 4 equipment in the Home Air Command.

Alternatives:

Acceptable product

U.S. MIL–L–9000E Military Symbol 9250
Emergency substitute
Canadian 3–GP–903 Grade 30

Stores Numbers:

Nato Code No.	*Joint Service Catalogue No.*	*Package*	*Navy*	*Army*	*R.A.F.*
O–248	9150–99–942–6393	45 gal	K/9426393	—	34D/9426393

OMD-170

OBSOLESCENT

Being replaced by OMD–270

OMD-270

(Aero Engine Oil Grade B/2)

Specification: D. Eng. R.D. 2472 Issue No. 2 Grade B/2.

Composition: Mineral oil containing approved detergent additives.

Characteristics:

Viscosity at 210°F	18·80–21·15 cS
„ index, min.	95
Pour point, max.	10°F (−12°C)
Flash point, open, min.	470°F (243°C)

Type test. The oil must satisfactorily pass an engine test under conditions approved by the Ministry of Aviation (Eng. R.D. 6). A list of approved oils is given in APL–2472. A proprietary detergent oil is used in Bristol Centaurus engines in Transport Command.

Uses: Lubrication of certain air cooled aircraft piston engines.

Stores Numbers:

Nato Code No.	*Joint Service Catalogue No.*	*Package*	*Navy*	*Army*	*R.A.F.*
O–127	9150–99–910–0584	45 gal	K/9100584	—	34A/9100584
	9150–99–944–0426	4½ gal	—	AAC	—

OMD-330

Specification: DEF–2101–B. Am. 1 (Includes OMD–40 and 110).

Composition: A refined mineral oil with additives.

Characteristics:

Viscosity at 210°F	16·8-22·8 cS (S.A.E. 50)
„ index, min.	75
Pour point, max.	15°F (−9·5°C)
Flash point, open, min.	400°F (204°C)
Approximate temperature for viscosity of 6,000 cS	40°F (4°C)

Meets engine test and other requirements indicated in the note on page 22.

Use: Lubrication of certain water-cooled and air-cooled engines. Similar purposes to OMD–110 where the ambient temperature is persistently above 90°F. Enclosed gearing where specified. When first adopted for engine lubrication, change-over instructions must be strictly observed.

Alternatives:

Standardised products

U.S. MIL–L–2104A Am. 1 Grade 50
Canadian 3–GP–395a

Stores Numbers:

Nato Code No.	*Joint Service Catalogue No.*	*Package*	*Navy*	*Army*	*R.A.F.*
O–182	9150–99–910–0585	4½ gal	0475/9100585	RASC	34D/9100585

OX-8

(Wide Temperature Range Hydraulic Brake Fluid)

Specification: C.S. 3106.

Composition: Must not contain mineral oil or any component deleterious to natural rubber.

Characteristics:

Viscosity at 210°F	1·5 cS min.
„ „ −40°F	1800 „ „

Requirements include performance tests at 70°C and −40°C, swelling of natural rubber, water tolerance, corrosion of metals and oxidation stability.

Uses: Intended to replace both OF–3 and OF–24 in hydraulic brake system containing natural rubber components over an ambient temperature range of −40°F to + 125°F.

Alternatives:

Standardised products

U.S. VV–H–910

Canadian 3–GP–510C.

Stores Numbers:

Nato Code No.	*Joint Service Catalogue No.*	*Package*	*Navy*	*Army*	*R.A.F.*
H–542	9150–99–220–2348	1 quart	+	+	34D/2202348

OX-10

Specifications: DEF–2182.

Composition: A "Diester" synthetic oil (di-2-ethylhexyl sebacate) and an oxidation inhibitor.

Characteristics:

Viscosity at 100°F	10 to 13 cS
„ „ −40°F max.	2,000 cS
Pour Point, max.	−65°F (−54°C)
Surface tension (dynes/cm), min. ...	30

The oil must pass tests for oxidation, volatility and low temperature stability.

Use: Lubrication of mechanical time fuzes and similar mechanisms.

Stores Numbers:

Nato Code No.	*Joint Service Catalogue No.*	*Package*	*Navy*	*Army*	*R.A.F.*
—	9150–99–910–0586	1 oz. bottle	+	RASC	—

OX-12

(Corrosion-inhibiting instrument oil)

Specification: D.T.D. 561.

Composition: A low viscosity mineral oil containing an approved corrosion inhibitor.

Characteristics:

Viscosity at 32°F, max.	100 cS (406 R.S.)
,, ,, 100°F, min.	12 cS (58 R.S.)
Cold test, must pass at	−50°C (−58°F)

Must pass corrosion resistance tests on copper at 100°C for 24 hours and on steel in contact with sea water at room temperature for 24 hours.

Uses: Lubrication of gimbal bearings of Admiralty gyro sights and other instruments. Also A/S fuzes, submarine torpedo tube power loading gear.

Alternatives:

Related products

U.S. MIL–L–644A
Canadian 3–GP–335a

Stores Numbers:

Nato Code No.	*Joint Service Catalogue No.*	*Package*	*Navy*	*Army*	*R.A.F.*
—	9150–99–910–0587	1 pint	0475/9100587	—	—

OX-13

Specification: C.S. 2842 and K.1476 (Includes OX–52)

Composition:

Mineral oil OM–13	85%
Oleic acid	13·5%
Triethanolamine...	1·5%

Characteristics: Cleansing and rust-preventing properties combined with effectiveness as a lubricant. Slowly attacks brass.

Uses: Cleaning, preservation and lubrication at low temperatures of small arms, machine guns except in aircraft and large calibre guns. Must not be left in prolonged contact with brass.

Stores Numbers:

Nato Code No.	*Joint Service Catalogue No.*	*Package*	*Navy*	*Army*	*R.A.F.*
—	9150–99–910–0588	4½ gal	0475/9100588	RASC	—
	9150–99–943–3222	5 gal	—	RASC	—

OX-14

(Low Temperature Oil)

Specification: D.T.D. 822A. Am. 1.

Composition: Non-petroleum materials such as diesters, with corrosion and oxidation inhibitors.

Characteristics:

Viscosity at 130°F, min.	8 cS
„ „ −65°F, max.	12,000 cS
Pour point, max.	−70°F, (−57°C)
Flash point, open, min.	365°F (185°C)

Uses: Lubrication of aircraft instruments, electronic equipment and aircraft controls where grease lubrication is not practicable. Unsuitable for use with natural and neoprene rubbers. Also affects certain paints and plastics.

Alternative:

Standardised products

U.S. MIL-L-6085A
Canadian MIL-L-6085A

Stores Numbers:

Nato Code No.	*Joint Service Catalogue No.*	*Package*	*Navy*	*Army*	*R.A.F.*
O-147	9150-99-910-0589	2 oz. bottle	0475/9100589	—	34B/9100589
	9150-99-910-0590	8 oz. bottle	34B/9100590	—	34B/9100590

OX-15

Specification: D.T.D. 5540.

Composition: OM-15 plus an approved corrosion inhibitor.

Characteristics: Similar to OM-15 but more viscous at low temperatures. It cannot therefore replace OM-15 for full time use as an aircraft hydraulic fluid.

Viscosity at −40°F, max. ... ... 800 Cs

Use: Preservative oil for aircraft hydraulic systems in storage.

Alternatives:

Standardised products

U.S. MIL-H-6083B Type 1
Canadian MIL-H-6083B Type 1

Stores Numbers:

Nato Code No.	*Joint Service Catalogue No.*	*Package*	*Navy*	*Army*	*R.A.F.*
C-635	Pending	—	—	—	Pending

OX-16

Specification: D.T.D. 900/4386 (Proprietary product).

Composition: A silicone base fluid with additivies.

Use: As liquid spring in oleo legs of aircraft. R.A.F. and Fleet Air Arm use only.

Stores Numbers:

Nato Code No.	*Joint Service Catalogue No.*	*Package*	*Navy*	*Army*	*R.A.F.*
—	9150-99-942-3149	2 oz. bottle	34B/9423149	—	34B/9423149
	9150-99-942-9494	½ gal	34B/9429494	—	—

OX-23

(Oil, Gear, Synthetic)

Specification: D.T.D. 896.

Composition: Aliphatic diesters, or other synthetic oil, with or without approved additives.

Characteristics:

Viscosity at 210°F, min.	5 cS
„ „ 100°F, max.	22·5 cS
„ „ −40°F (special test method) max. ...	4·500 cS
Pour point, max.	−76°F (−60°C)

Other tests include acidity, corrosion, oxidation, evaporation loss, stability at low temperature and stability under shear.

Use: Lubrication of gearboxes of powered flying controls in certain aircraft.

Stores Numbers:

Nato Code No.	*Joint Service Catalogue No.*	*Package*	*Navy*	*Army*	*R.A.F.*
O-158	9150-99-942-3150	½ pint tin	—	—	34B/9423150

OX-38

(Lubricating Oil, Aircraft Turbine Engine, Synthetic Type)

Specification: D. Eng. R.D. 2487 Issue No. 4.

Composition: Synthetic. Suitable anti-oxidants, E.P. compounds and polymeric thickening agents may be incorporated.

Characteristics:

Viscosity at −40°F, max.	13,000 cS
„ „ 100°F, max.	39 cS
„ „ 210°F, min.	7·5 cS
Flash point, open, min.	420°F (216°C)

Tests covering performance in engines, load carrying capacity, stability under shear, high temperature bearing lubrication, corrosiveness and oxidation resistance, are included in the specification. Products from three oil companies have been approved.

Uses: Lubrication of all latest U.K. turbo-jet and turbo-prop aircraft engines and relevant auxiliary equipment and cold air units.

Alternatives: Up to 50% of U.S. MIL–L–7808 oil may be used to top up an engine normally using OX–38 but in emergency only.

Stores Numbers:

Nato Code No.	*Joint Service Catalogue No.*	*Package*	*Navy*	*Army*	*R.A.F.*
O–149	9150–99–942–4819	4 oz. tube	K/9424819	—	34B/9424819
	9150–99–910–0591	1 gal	K/9100591	—	34A/9100591

OX-52

(Oil A)

Specifications: C.S. 2842 and K.1476 (Includes OX–13).

Composition:

Oil OM–41 to C.S. 2902 (K. 1477) ...	85%
Oleic acid	13·5%
Triethanolamine	1·5%

Characteristics: Lubricating, cleansing and rust-preventing properties. Slowly attacks brass.

Uses: Lubrication, cleaning and preservation at medium to high ambient temperatures of small arms and machine guns (not aircraft). Must not be left in prolonged contact with brass.

Alternatives:

Emergency substitutes

U.S. MIL–L–3150 and MIL–L–21260 Grade 2
Canadian 3–GP–367a

Stores Numbers:

Nato Code No.	*Joint Service Catalogue No.*	*Package*	*Navy*	*Army*	*R.A.F.*
O–194	9150–99–910–0592	5 gal	0475/9100592	RASC	34D/9100592

OX-275

Specification: DEF–2181–A.

Composition: Oil OM–270 (D. Eng. R.D. 2472 B/O) plus an approved corrosion inhibitor concentrate.

Characteristics:

Viscosity at 210°F	18–22·5 cS
„ index, min.	93
Pour point, max.	20°F (−6·7°C)
Flash point, open, min.	350°F (177°C)

The oil must pass special corrosion prevention tests.

Use: As a corrosion preventing oil for aircraft piston engines, circulated during final running on test bed and in installed engines when an aircraft is prepared for storage. OX–275 is formulated to neutralise the corrosive effects of the products of combustion of leaded petrol.

Stores Numbers:

Nato Code No.	*Joint Service Catalogue No.*	*Package*	*Navy*	*Army*	*R.A.F.*
C-615	9150–99–910–0593	5 gal	K/9100593	—	34B/9100593

OX-320

(Oil, Graphited, Concentrate)

Specification: C.S. 1419C.

Composition:

Mineral oil	90%
Graphite	10%

Characteristics:

Viscosity at 140°F	350–400 R.S. (86–98 cS)
Pour point, max.	32°F (0°C)
Flash point, min.	383°F (195°C)

98% of the graphite particles must not exceed 5 microns (0·005 mm) in diameter. The remaining 2% must not exceed stated limits in size and the whole of the material must pass through a 240 mesh B.S. sieve.

Uses: Lubrication of gun slides and cradle guideways, certain breech mechanisms and Bofors gun equipment and for guided weapon maintenance.

Alternative:

Standardised product

Canadian 3–GP–400

Stores Numbers:

Nato Code No.	*Joint Service Catalogue No.*	*Package*	*Navy*	*Army*	*R.A.F.*
O-218	9150–99–943–1552	3 oz. tin	0474/9431552	—	—
	9150–99–942–8387	1 pint tin	—	RASC	—
	9150–99–910–0594	4½ gal	—	RASC	34D/9100594
	9150–99–220–2126	5 gal	—	—	34D/2202126

OX-520

(Oil Graphited ZA)

Specification: Proprietary.

Use: Lubrication of breech blocks and threads of Naval guns.

Stores Numbers:

Nato Code No.	*Joint Service Catalogue No.*	*Package*	*Navy*	*Army*	*R.A.F.*
—	9150–99–910–0595	1 gal	0474/9100595	—	—

Other miscellaneous oils are listed as "specialities" on pages 48 to 52.

ZX–1 A soluble cutting oil.
ZX–2 A clear soluble cutting oil.
ZX–3 A hydraulic soluble oil.
ZX–6 Sulphurised cutting oils.
ZX–7 and ZX–8 Bitumen base oils.
ZX–15 A water-emulsifiable oil.

Section II. Greases

LG-190

Specification: C.S. 2985 (Includes LG–280 and LG–320).

Composition: Mineral oil and calcium soap.

Characteristics:

Viscosity of mineral oil at 100°F, min.	20 cS
Closed flash point of mineral oil, min. ...	315°F (157°C)
Worked penetration	175–205
Drop point, min.	100°C (212°F)

Other tests include: water content, acidity and alkalinity, and corrosion.

Uses: For vehicle engine coolant pumps where specified, and for submarine torpedo tube fittings. For temperatures below 0°F (−18°C) LG–380 is more suitable.

Alternatives:

Acceptable products

U.S. MIL–G–10924A
Canadian 3–GP–685b

Stores Numbers:

Nato Code No.	*Joint Service Catalogue No.*	*Package*	*Navy*	*Army*	*R.A.F.*
G–400	9150–99–910–0501	7 lb	0474/9100501	RASC	34D/9100501

LG-280

Specifications: C.S. 2985 and K. 831C (C.S. 2985 includes LG–190 and LG–320).

Composition: Mineral oil and calcium soap.

Characteristics:

Viscosity of mineral oil at 100°F, min.	110 cS
Closed flash point of mineral oil, min. ...	350°F (177°C)
Worked penetration	260–300
Drop point, min.	100°C (212°F)

Other tests include water content, acidity and alkalinity, corrosion, heat stability, and pumpability after 24 hours at −18°C (0°F).

Uses: As a general purpose grease in moderate and high ambient temperature conditions: for lubrication of artillery, and in ball bearings running at moderate and in some cases high speeds, but not in electrical machines in H.M. Ships. Also for torpedo tube fittings and torpedo lubrication.

LG–280 has been widely used as a temporary protective, see page 66, PX–19.

Alternatives:

Acceptable products
U.S. MIL–G–10924A
Canadian 3–GP–685b

Stores Numbers:

Nato Code No.	*Joint Service Catalogue No.*	*Package*	*Navy*	*Army*	*R.A.F.*
G–404	9150–99–910–0502	7 lb	0474/9100502	RASC	34D/9100502

LG-320

Specifications: C.S. 2985 (Includes LG–190 and LG–280).

Composition: Mineral oil and calcium soap.

Characteristics:

Viscosity of mineral oil at 100°F., min.	160 cS
Closed flash point of mineral oil, min. ...	350°F (177°C)
Worked penetration	310–340
Drop point, min.	70°C

Other tests include water content, acidity and alkalinity, corrosion, heat stability and pumpability at 0°C (32°F).

Uses: Vehicle chassis and Caterpillar tractor lubrication, wheel bearings of AFVs. For temperatures above 20°F (−7°C).

Alternatives:

Acceptable products
U.S. MIL–G–10924A
Canadian 3–GP–685b

Stores Numbers:

Nato Code No.	*Joint Service Catalogue No.*	*Package*	*Navy*	*Army*	*R.A.F.*
G–405	9150–99–910–0503	7 lb	0474/9100503	RASC	34D/9100503

LG-380

Specification: DEF-2221-A.

Composition: A soft, low temperature grease made from a low-viscosity oil and water-insoluble soap (normally calcium soap).

Characteristics:

Viscosity of mineral oil at 100°F, min.	13 cS
Closed flash point of mineral oil, max.	290°F (143°C)
Apparent viscosity, poises at −40°C ...	
max.: at rate of shear 25 sec^{-1} ...	2,500
„ „ „ „ 100 sec^{-1} ...	500
Drop point, min.	90°C (194°F)

Oil separation, acidity and alkalinity, and corrosion tests are included.

Uses: Low temperature lubrication (except for aircraft) including vehicle chassis, road and idler wheels of AFV's, clutch withdrawal bearings, etc., at severe winter and arctic temperatures, general lubrication of fire control instruments; also for protection of ammunition and of small arms in landing operations and of exposed parts of naval gun mountings at low temperatures. Also for torpedo tube mechanisms and torpedo lubrication.

Alternatives:

Acceptable products

U.S. MIL-G-10924A
Canadian 3-GP-685b

Stores Numbers:

Nato Code No.	*Joint Service Catalogue No.*	*Package*	*Navy*	*Army*	*R.A.F.*
G-406	9150-99-910-0504	7 lb	0474/9100504	RASC	34D/9100504

XG-220

Specification: C.S. 2911A.

Composition:

XG-271 grease	60% by wt.
C.S. 1050B graphite (size 170) ...	40% by wt.

Characteristics:

Penetration... 185-260

Use: Lubrication of turret races of AFVs.

Stores Numbers:

Nato Code No.	*Joint Service Catalogue No.*	*Package*	*Navy*	*Army*	*R.A.F.*
—	9150-99-910-5060	28 lb	—	RASC	—

XG-235

Specifications: MIL–G–6032A Am. 1.

Composition: A hydrocarbon resistant grease.

Use: In refuelling vehicles where lubricated surfaces might come in contact with fuel. Replacing XG–410.

Alternative:

Standardised product

Canadian 3–GP–686a

Stores Numbers:

Nato Code No.	*Joint Service Catalogue No.*	*Package*	*Navy*	*Army*	*R.A.F.*
G–363	9150–99–944–0585	1 lb	34B/9440585	—	34B/9440585

XG-250

Specification: D.T.D. 900/4298.

Composition: A silicone compound.

Uses: In electrical equipment for insulation and sealing.

Alternatives:

Standardised products

U.S. MIL–I–8660 Am. 2

Canadian do.

Stores Numbers:

Nato Code No.	*Joint Service Catalogue No.*	*Package*	*Navy*	*Army*	*R.A.F.*
S–736	6850–99–942–4829	—	0474/60807	H1/9424829	33C/9424829

XG-261

Specification: D.T.D. 900/4662.

Composition: A silicone grease.

Use: Lubrication of metal to rubber seals in radar scanner equipment.

Stores Numbers:

Nato Code No.	*Joint Service Catalogue No.*	*Package*	*Navy*	*Army*	*R.A.F.*
—	9150–99–220–2357	1 lb tube	0474/2202357	—	—

XG-265

Specification: D.T.D. 900/4222.

Composition: A synthetic diester plus a gelling agent.

Uses: In certain aircraft turbine engine gear boxes and in anti-icing equipment. Wide operating temperature −60°C to + 180°C.

Stores Numbers:

Nato Code No.	*Joint Service Catalogue No.*	*Package*	*Navy*	*Army*	*R.A.F.*
—	9150-99-943-3481	4 oz	—	—	34B/9433481

XG-266

Specification: D.T.D. 900/4667.

Composition: XG-265 plus 2 per cent molybdenum disulphide.

Uses: Lubrication of generators and gyro bearings in guided weapon equipment, wide operating temperature range.

Stores Numbers:

Nato Code No.	*Joint Service Catalogue No.*	*Package*	*Navy*	*Army*	*R.A.F.*
—	9150-99-943-3482	2 oz	—	—	34B/9433482

XG-271

Specification: DEF-2261.

Composition: A smooth homogeneous grease, consisting essentially of petroleum oil and a thickening agent.

Characteristics:

Penetration... 250–300
Drop point, min. ... ... 300°F (149°C)

Other tests include low temperature torque at −40°C, bleeding, corrosion, water resistance and high temperature bearing performance.

Uses: Wide temperature range lubrication of high-speed ball and roller bearings except in certain Naval applications: magnetos and other electrical auxiliaries in engine units; certain fire-control instruments; lubrication and protection of arresting gears. Not for helicopters (see XG-284).

Alternatives:

Standardised products

U.S. MIL-L-7711
Canadian 3-GP-682 Am. 2.

Stores Numbers:

Nato Code No.	*Joint Service Catalogue No.*	*Package*	*Navy*	*Army*	*R.X.F.*
G-382	9150-99-910-0510	4 oz tube	34B/9100510	—	34B/9100510
	9150-99-943-1550	1 lb	0474/9431550	—	—
	9150-99-910-0511	7 lb	0474/9100511	RASC	34D/9100511

XG-272

OBSOLESCENT

Being replaced by XG–284

XG-273

Specification: D.T.D. 900/4408.

Composition: XG–275 grease containing graphite.

Characteristics: Suitable for low temperature use.

Uses: Lubrication of Bowden Brake Cables. R.A.F. and Fleet Air Arm use only.

Stores Numbers:

Nato Code No.	*Joint Service Catalogue No.*	*Package*	*Navy*	*Army*	*R.A.F.*
G–357	9150–99–942–3151	4 oz tube	34B/9423151	—	34B/9423151

XG-274

Specification: D.G.S. 6921.

Composition: Mineral oil and a gelling agent.

Uses: Lubrication of large ball and roller bearings in electrical equipment. Naval use only.

Stores Numbers:

Nato Code No.	*Joint Service Catalogue No.*	*Package*	*Navy*	*Army*	*R.A.F.*
—	9150–99–943–9814	7 lb	0474/9439814	—	—

XG-275

(Low Temperature Grease)

Specification: D.T.D. 825A.

Composition: A smooth homogeneous mixture consisting essentially of a metallic soap or other gelling agent and a liquid lubricant of low pour point.

Characteristics:

Penetration...	260–310
Drop point, min.	325°F (163°C)
Apparent viscosity, poises at −54°C (−65°F), max. at rate of shear 20sec.$^{-1}$	10,000

Specification includes high temperature rig test, low temperature torque at −54°C, working stability and bleeding tests.

Uses: General low temperature lubrication of aircraft and lubrication of frigate torpedo tube firing gear. Suitable for operating temperature range 54°C (−65°F) to + 120°C (248°F). Unsuitable for use with natural and neoprene rubbers. Also affects certain paints and plastics.

Alternatives:

Standardised products

U.S. MIL-G-3278A

Canadian 3-GP-683a Am. 3

Stores Numbers:

Nato Code No.	*Joint Service Catalogue No.*	*Package*	*Navy*	*Army*	*R.A.F.*
G-350	9150-99-910-0512	4 oz tube	(0474/9100512) (34B/9100512)	AAC	34B/9100512
	9150-99-910-0513	1 lb	—	—	34B/9100513

XG-276

Specification: D.T.D. 900/4420 or 4439.

Typical Composition: XG-275 grease containing molybdenum disulphide.

Characteristics: Remains workable at low temperatures.

Use: On small high-speed plain bearings and low efficiency screw threads. Aircraft use only.

Stores Numbers:

Nato Code No.	*Joint Service Catalogue No.*	*Package*	*Navy*	*Army*	*R.A.F.*
—	9150-99-942-5139	4 oz tube	34B/9425139	—	34B/9425139

XG-277

(High Temperature Grease)

Specification: D.T.D. 878A.

Composition: A smooth homogeneous grease, consisting essentially of a petroleum oil and a thickening agent.

Characteristics:

Penetration (worked)	250–300
Drop point, min.	350°F (177°C)

Passes tests for high temperature performance, oxidation resistance, water resistance, storage stability and corrosion.

Uses: Certain engine-drive accessories and wheel bearings on aircraft when low temperature will not be encountered. Hydro-mechanical clutches on helicopters.

Alternatives:

Standardised products

U.S. MIL-L-3545
Canadian 3-GP-690a

Stores Numbers:

Nato Code No.	*Joint Service Catalogue No.*	*Package*	*Navy*	*Army*	*R.A.F.*
G-359	9150-99-910-0514	1 lb tube	34B/9100514	—	34B/9100514
	9150-99-220-2322	7 lb tin	34B/2202322	—	—

XG-278

(Low Temperature Grease, Extreme Pressure)

Specification: D.T.D. 844A.

Composition: A smooth homogeneous mixture consisting essentially of a metallic soap or other thickening agent, a liquid lubricant, e.g. a diester of low pour point and an extreme-pressure additive.

Characteristics:

Penetration...	280–340
Drop point, min.	325°F (163°C)

Passes tests for apparent viscosity at definite rates of shear at −54°C, low temperature torque at −54°C, bleeding, working stability, load carrying capacity (mean Hertz load) and gear wear test.

Use: Lubrication of certain aircraft actuators.

Alternative:

Standardised products

U.S. MIL-G-7118A
Canadian 3-GP-606

Stores Numbers:

Nato Code No.	*Joint Service Catalogue No.*	*Package*	*Navy*	*Army*	*R.A.F.*
G-354	9150-99-910-5058	4 oz tube	34B/9105058	—	34B/9105058

XG-279

(Multi-purpose Automotive and Artillery Grease)

Specfication: C.S. 3107.

Composition: A petroleum oil with a gelling agent.

Characteristics:

Penetration	250–300
Apparent viscosity at −65°F	
rate of shear 25 sec. $^{-1}$ Poises ...	11,500 min. 17,500 max.
„ „ „ 100 sec. $^{-1}$ Poises ...	8,500 max.

Requirements include a performance test in roller bearings and limits on solid particle content, evaporation loss, oil separation, oxidation stability, corrosion, working stability, water stability and salt spray resistance.

Uses: As a multi-purpose grease for automotive and artillery applications over an ambient temperature range of −65°F to +125°F. It is intended as a replacement for all of the following:— LG–380, LG–320, LG–280, LG–190 and XG–271 for non-aviation uses with certain exceptions. It will also replace OC–600 for chassis lubrication but NOT for transmission assemblies, steering boxes or similar applications.

Alternatives:

Standardised products

U.S. MIL–G–10924A
Canadian 3–GP–685b

Stores Numbers:

Nato Code No.	*Joint Service Catalogue No.*	*Package*	*Navy*	*Army*	*R.A.F.*
G–403	—	—	+	+	+

XG-280

Specification: C.S. 1653D and E. 1137.

Composition:

Lime-base grease	95%
Graphite (size 170)	5%

Characteristics: As quoted for LG-280.

Uses: Leaf spring and lift-guide lubrication; lubrication and protection of steel wire rope, anti-seize applications.

Alternatives:

Acceptable product

U.S. VV-G-671c, Grade 3 or MIL-G-7187
Canadian 3–GP–64/a

Stores Numbers:

Nato Code No.	*Joint Service Catalogue No.*	*Package*	*Navy*	*Army*	*R.A.F.*
G–412	9150–99–910–0516	7lb tin	E8/9100516	RASC	34D/9100519

XG-284

Specification: D.T.D. 900/4609.

Composition: A general purpose helicopter and anti-fretting grease.

Uses: In helicopters and blade root bearings of de Haviland variable pitch propellers operating temperature range −54 to + 70°C.

Alternatives:

Standardised products

U.S. MIL-G-25537 (USAF) Am. 1
Canadian 3-GP-687

Stores Numbers:

Nato Code No.	*Joint Service Catalogue No.*	*Package*	*Navy*	*Army*	*R.A.F.*
G-366	9150-99-943-9321	1 lb	34B/9439321	—	34B/9439321
	9150-99-220-2310	28 lb	34B/2202310	—	—

XG-285

(Graphited Grease)

Specification: D.T.D. 806.

Composition: A grease equivalent to XG-271, plus 5% of graphite.

Characteristics:

Penetration...	265-340
Drop point, min.	300°F (149°C)
Texture	Smooth and homogeneous.

Must pass a low-temperature torque test (−40°C) bleeding and corrosion tests. 98% of the graphite must pass through a 200 mesh sieve.

Use: For combustion starters in aircraft and certain generating sets.

Alternatives:

Standardised products

U.S. MIL-G-7187
Canadian 3-GP-641a

Stores Numbers:

Nato Code No.	*Joint Service Catalogue No.*	*Package*	*Navy*	*Army*	*R.A.F.*
G-355	9150-99-910-0517	4 oz tube	(34B/9100517) (0474/9100517)	AAC	34B/9100517

XG-290

(Low Temperature Grease)

Specification: D.T.D. 577.

Composition: Essentially petroleum oil and lithium soap.

Characteristics:

Penetration...	250–350
Drop point, min.	300°F (149°C)
Texture	Homogeneous

Must pass a low temperature torque test at −55°F, and tests for water resistance, oxidation, corrosion, bleeding and loss by evaporation.

Uses: In electronic equipment and Shackleton aircraft propellers. R.A.F. and Naval Air use only. Has been replaced by XG–275 except where it may come in contact with neoprene rubbers which would be attacked by the synthetic component of XG–275.

Stores Numbers:

Nato Code No.	*Joint Service Catalogue No.*	*Package*	*Navy*	*Army*	*R.A.F.*
—	9150–99–910–5057	4 oz tube	34B/9105057	AAC	34B/9105057

XG-295

(Extreme Low Temperature Grease)

Specification: D.T.D. 866.

Composition: Essentially a mixture of a gelling agent with a liquid lubricant of low pour point.

Characteristics:

Penetration...	260–330
Drop point, min.	325°F, (163°C)
Apparent viscosity at −100°F and rate of shear 20 sec. $^{-1}$ max.	15,000 poises

Must pass high temperature rig test, low temperature torque at −100°F, and tests for gear wear, oil separation and working stability.

Uses: General lubrication below −65°F, and for certain equipment above −65°F where power is insufficient for operation on XG–275.

Alternatives:

Standardised products

U.S. MIL–G–7421A
Canadian MIL–G–7421A

Stores Numbers:

Nato Code No.	*Joint Service Catalogue No.*	*Package*	*Navy*	*Army*	*R.A.F.*
G–352	9150–99–942–3152	4 oz tube	34B/9423152	—	34B/9423152

XG-310

Specification: Admiralty "Grease, Non-floating".

Composition: Water-insoluble soap and lubricating oil with or without fillers and colouring matter.

Characteristics:

Specific gravity at 60°F	1·2 min.
Penetration at 77°F	280–320
„ „ 32°F (using steel cylinder apparatus)	not less than 1 in
Drop point, min.	80°C (176°F)

A dark-coloured grease suitable for lubrication and protection against corrosion of mechanisms submerged in seawater. Must pass tests for separation, out-door exposure, workability after 2 hours at 10°F (−12°C), resistance to water-washing and absence of oily slick. The filler must pass a 240 B.S. sieve.

Uses: For mechanisms exposed to washing action of sea, such as external equipment of submarines (including armament), mine swivels and sinkers. Also for lubrication of frigate torpedo tube training gear.

Alternatives:

Related products

U.S. 16-L-5 Type A
Canadian 3-GP-651

Stores Numbers:

Nato Code No.	*Joint Service Catalogue No.*	*Package*	*Navy*	*Army*	*R.A.F.*
—	9150-99-910-0518	7 lb tin	0474/9100518	—	—

XG-315

Specification: D.T.D. 897.

Composition: A silicone grease.

Characteristics:

Penetration...	260–310
Drop point, min.	392°F (200°C)
Apparent viscosity at −85°F (−65°C) and rate of shear 20 sec $^{-1}$ max. ...	10,000 poises

Must pass a storage stability test.

Use: Metal to rubber lubrication in aircraft pneumatic systems and guided weapons.

Alternatives:

Related products

U.S. MIL-L-4343A Am. 1
Canadian 3-GP-605

Stores Numbers:

Nato Code No.	*Joint Service Catalogue No.*	*Package*	*Navy*	*Army*	*R.A.F.*
G-394	9150-99-910-0519	1 oz tube	34B/9100519	—	34B/9100519
	9150-99-944-0603	1 lb tin	—	+	—

XG-340

(*Grease, Graphited, RD 1179A*)

Specification: C.S. 2592C.

Composition:

Aluminium...	12%
Mineral oil (17–20 cS at 60°C)	82%
Graphite (size 170)	6%

Characteristics.

Penetration...	300–350
Stable after one hour at 75°C (167°F)	

Use: Lubrication of certain small arms at high ambient temperatures.

Stores Numbers:

Nato Code No.	*Joint Service Catalogue No.*	*Package*	*Navy*	*Army*	*R.A.F.*
—	9150-99-960-2483	¾ oz tube	0474/9602483	RASC	—
	9150-99-910-0520	7 lb tin	0474/9100520	—	—

XG-344

Specification: D.T.D. 900/4309 (Proprietary).

Composition: Aluminium soap grease containing an adhesive agent.

Uses: On certain aircraft turbine engine starters. R.A.F. and Naval Air use only.

Stores Numbers:

Nato Code No.	*Joint Service Catalogue No.*	*Package*	*Navy*	*Army*	*R.A.F.*
—	9150-99-910-5056	1 lb tin	—	—	34B/9105056

XG-460

Specification: D.T.D. 900/4651.

Composition: Semi-fluid grease containing colloidal graphite and an extreme-pressure additive.

Use: On breech-blocks and threads of large Naval guns (replacing OX-520). Works well on phosphated surfaces.

Stores Numbers:

Nato Code No.	*Joint Service Catalogue No.*	*Package*	*Navy*	*Army*	*R.A.F.*
—	9150-99-910-0524	7 lb tin	0474/9100524	—	—

Other miscellaneous greases are listed as "Specialities" on pages 52 to 54 under the designations:

ZX-13, a Graphited Mineral Jelly.

ZX-14, a Petrol-resistant Grease.

ZX-16, an Optical Eyepiece Grease.

ZX-26, A Tail-plane Actuator Grease.

Section III. Specialities

ZX-1

Specification: C.S. 2997A. (Includes ZX–2).

Composition: Mineral lubricating oil with emulsifiers, stabilisers, antiseptics and not more than 10% of water.

Characteristics: A high-grade "soluble oil". Forms a stable, milky non-frothing emulsion with hard or soft water. The emulsion is better than plain lubricating oil as a coolant, but less efficient as a lubricant. As a protective against rusting of machine tools and workpieces it is effective for a limited time (shorter under humid conditions) and it is practically inert to copper. It should be excluded from enclosed mechanisms such as ball bearings and gear-boxes.

Use: For general metal-cutting purposes as an emulsion in water, usually at a concentration of about 1 in 30. Higher concentrations are used to improve performance as a lubricant and corrosion preventative, but beyond about 1 in 7 the improvement ceases to be significant.

Alternatives:

Standardised products

U.S. VV–C–846
Canadian 3–GP–344a

Stores Numbers:

Nato Code No.	*Joint Service Catalogue No.*	*Package*	*Navy*	*Army*	*R.A.F.*
O–214	9150–99–910–0558	5 gal	0475/9100558	RASC	34D/9100558

ZX-2

Specification: C.S. 2997A. (Includes ZX–1).

Composition: Mineral lubricating oil with emulsifiers, stabilisers, antiseptics and not more than 15% of water.

Characteristics: Forms a stable, non-frothing, transparent emulsion with hard or soft water. The lubricating properties of the emulsion are adequate, but the emphasis is on its convenience as a transparent fluid and good performance as a coolant. Although generally used at lower concentrations than ZX–1 it is equally satisfactory as a protective against corrosion and is practically inert to copper. In grinding it affords greater freedom from wheel glazing than do milky emulsions.

Use: For grinding purposes, usually at a concentration of about 1 in 60. For cutting purposes a higher concentration is frequently used.

Stores Numbers:

Nato Code No.	*Joint Service Catalogue No.*	*Package*	*Navy*	*Army*	*R.A.F.*
—	9150–99–910–0559	5 gal	0475/9100559	—	34D/9100559

ZX-3

Specification: Admiralty "Oil, Hydraulic Soluble", 28/Lubr/7 Proprietary.

Composition: A homogeneous mixture of mineral oil, woolgrease, potassium oleate and water.

Characteristics: Forms a milky emulsion with water which "creams" more readily than other soluble oil emulsions, depositing a greasy film which assists in lubricating gland seals. This characteristic calls for periodic additions of oil to maintain the concentration.

Use: In certain large naval hydraulic systems, usually at a minimum concentration of 1 in 40.

Stores Numbers:

Nato Code No.	*Joint Service Catalogue No.*	*Package*	*Navy*	*Army*	*R.A.F.*
—	9150–99–910–0568	5 gal	0475/9100568	—	—

ZX-6

Specification: DEF–2301–A.

Composition: A homogeneous mixture of mineral oil and sulphurised mineral or fatty oil, containing a minimum of 1% added sulphur, and a minimum of 10% fatty matter.

Characteristics:

Viscosity at 100°F	30–50 cS
Flash point, closed, min.	300°F (150°C)

Use: In machining operations where particularly efficient lubrication of the tool is required.

Alternatives:

Standardised products

U.S. VV–V–850 Type 2 Grade B
Canadian 3–GP–334a

Stores Numbers:

Nato Code No.	*Joint Service Catalogue No.*	*Package*	*Navy*	*Army*	*R.A.F.*
O–216	9150–99–910–0562	5 gal	0475/9100562	RASC	34D/9100562

ZX-7

Specification: DEF–2302 (Includes ZX–8).

Composition: A vacuum-reduced petroleum residue, or a blend of unblown bitumen and mineral oil.

Characteristics: A black viscous adhesive fluid.

Viscosity at 210°F	140–160 R.S. 2 (approx. 390 cS)
Flash point, open, min.	400°F (204°C)
Lower pour point, max.	100°F (38°C)

Use: Lubrication of open gears of winches and concrete mixers. Also of wire ropes.

Alternatives:

Acceptable products

U.S. VV–L–751a (Type 2. Grade C)
Canadian 3–GP–662a

Stores Numbers:

Nato Code No.	*Joint Service Catalogue No.*	*Package*	*Navy*	*Army*	*R.A.F.*
O–200	9150–99–910–0596	5 gal	0475/9100596	RASC	34D/9100596

ZX-8

Specification: DEF–2302 (Includes ZX–7).

Composition: A vacuum-reduced petroleum residue, or a blend of unblown bitumen and mineral oil.

Characteristics: A black, adhesive fluid, like ZX–7 but less viscous.

Viscosity at 210°F	45–55 R.S. 2 (approx. 115–125 cS)
Flash point, open, min.	400°F (204°C)
Consistency at 32°F. (I.P. penetration, unworked)	270–300
Lower pour point, max.	60°F (16°C)

Uses: Similar to ZX–7. Low temperature grade.

Alternatives:

Acceptable products

U.S. VV–L–751a Type 2, Grade A
Canadian 3–GP–661

Stores Numbers:

Nato Code No.	*Joint Service Catalogue No.*	*Package*	*Navy*	*Army*	*R.A.F.*
O–198	9150–99–910–0597	28 lb keg	0475/9100597	RASC	34D/9100597
	9150–99–943–3221	5 gal	—	RASC	—

ZX-11

(Waterproof grease. Type A)

Specification: None. A proprietary product.

Composition: 75% tallow and 25% white lead paste.

Use: Prevention of corrosion of buoys, etc.

Stores Numbers:

Nato Code No.	*Joint Service Catalogue No.*	*Package*	*Navy*	*Army*	*R.A.F.*
—	8030–99–943–1549	1 gal	0474/9431549	—	—
	8030–99–910–0499	5 gal	—	—	34D/9100499

ZX-13

(Anti-Seize Grease for Threaded fittings)

Specifications: D.T.D. 392.

Composition:

Mineral jelly	50%
Graphite (100 mesh)	50%

Characteristics: Penetration worked, 150–190.

Use: On threads where specified, e.g. sparking plugs, but not oxygen equipment (see ZX–24).

Alternatives:

Standardised products

U.S. MIL–T–5544A (ASG)
Canadian 3–GP–802

Stores Numbers:

Nato Code No.	*Joint Service Catalogue No.*	*Package*	*Navy*	*Army*	*R.A.F.*
S–720	9150–99–910–0528	1 lb tin	(0474/9100528) (34B/9100528)	AAC	34B/9100528

ZX-14

Specification: D.T.D. 900/4422. Obsolescent. Replacement not available at time of going to press.

Charactistics: A stiff petrol-resistant grease.

Use: On cocks and glands of bulk fuel storage equipment.

Stores Numbers:

Nato Code No.	*Joint Service Catalogue No.*	*Package*	*Navy*	*Army*	*R.A.F.*
—	9150–99–910–0529	1 lb tin	0474/9100529	RASC	34D/9100529

ZX-15

Specification· None. Three proprietary products have been approved by Eng. R.D. 6 Ministry of Aviation.

Composition: A water-emulsifiable oil.

Use: As an anti-corrosion agent in aircraft piston engine power augmentation fluid AL–10 in which it is present to the extent of 1 per cent.

Stores Numbers:

Nato Code No.	*Joint Service Catalogue No.*	*Package*	*Navy*	*Army*	*R.A.F.*
	9150–99–910–0598	5 gal	34B/9100598	—	34B/9100598

ZX-16

Specification: None. A proprietary product.

Characteristics: A very sticky grease capable of preventing entry of moist air, mould spores and dust past screw threads.

Use: Lubrication of the eye-piece threads of binoculars, etc. Below 0°F it is replaced by LG–380.

Stores Numbers:

Nato Code No.	*Joint Service Catalogue No.*	*Package*	*Navy*	*Army*	*R.A.F.*
—	9150–99–910–0530	2 oz tin	0474/9100530	RASC	—

ZX-22

OBSOLESCENT

Being replaced by ZX–32.

ZX-24

Specification: D.T.D. 900/4042.

Composition: A dispersion of colloidal graphite in water.

Characteristics: A soft black paste.

Use: Lubrication of screw-threads of high-pressure oxygen systems.

Alternatives:

Emergency substitutes

U.S. MIL–T–5542 B (ASG)
Canadian do.

Stores Numbers:

Nato Code No.	*Joint Service Catalogue No.*	*Package*	*Navy*	*Army*	*R.A.F.*
S–718	8030–99–910–5066	½ oz. bottle	34B/9105066	RASC	—
	8030–99–942–7802	2¾ oz. jar	34/B9427802	—	34B/9427802

ZX-25

OBSOLESCENT

Being replaced by ZX–30.

ZX-26

Specification: D.T.D. 900/4402.
Composition: A lithium base-grease containing synthetic diesters.

Characteristics: A semi-fluid grease suitable for low-temperature use.

Use: Lubrication of tail-plane actuators on certain aircraft. R.A.F. and Naval Air use only.

Stores Numbers:

Nato Code No.	*Joint Service Catalogue No.*	*Package*	*Navy*	*Army*	*R.A.F.*
—	9150-99-942-6549	4 oz tube	34B/9426549	—	34B/9426549
	9150-99-942-3153	½ pint tin	34B/9423153	—	34B/9423153

ZX-28

Specification: D.T.D. 5530 Am. 1.

Composition: 50 per cent of molybedenum disulphide in a grease-like medium.

Use: As an anti-seize agent for metal parts which become heated in use.

Stores Numbers:

Nato Code No.	*Joint Service Catalogue No.*	*Package*	*Navy*	*Army*	*R.A.F.*
—	8030-99-943-7518	2 oz. tube	34B/9437518	—	34B/9437518
		1 lb	34B/9426900	—	—

ZX-29

(*Easing Oil*)

Specification: T.S. 321A.

Composition: A mixture of sperm oil, acetone and a petroleum distillate. Highly flammable.

Uses: For the removal of rusted components. e.g. Nuts and Bolts. A mixture of OM-21 or other light mineral oil with kerosine is frequently adequate.

Stores Numbers:

Nato Code No.	*Joint Service Catalogue No.*	*Package*	*Navy*	*Army*	*R.A.F.*
—	9150-99-944-0595	½ pint tin	—	RASC	+

ZX-30

Specification: D.T.D. 900/4639.

Composition: Colloidal graphite dispersed in ethanol.

Uses: For bomb release mechanisms and certain anti-seize applications.

Stores Numbers:

Nato Code No.	*Joint Service Catalogue No.*	*Package*	*Navy*	*Army*	*R.A.F.*
—	9150-99-944-0586	1¼ lb jar	34B/9440586	—	34B/9440586

ZX-31

Specification: R.A.E. Farnborough ARM 2685/3b.

Composition: Molybdenum disulphide to specification C.S. 2819 with small additions of stearic acid and sodium stearate.

Use: for certain bomb release mechanisms.

Stores Numbers:

Nato Code No.	*Joint Service Catalogue No.*	*Package*	*Navy*	*Army*	*R.A.F.*
—	8030-99-220-2150	1 oz bottle	34B/2202150	—	+

ZX-32

Specification: D.T.D. 900/4671.

Composition: A non-petroleum, non-flammable lubricant containing graphite.

Uses: As a sealant and anti-seize in threaded connections of both high and low pressure aircraft oxygen systems up to a pressure of 2000 p.s.i.

Alternatives:

Standardised products

U.S. MIL-T-5542 B (ASG)
Canadian MIL-T-5542 B (ASG)

Stores Numbers:

Nato Code No.	*Joint Service Catalogue No.*	*Package*	*Navy*	*Army*	*R.A.F.*
S-717	—	—	+	—	+

Section IV. Temporary Protectives

PX-1

Specification: DEF–2331–A.

Composition: Two grades are available i.e. dyed and undyed.

	Dyed	*Undyed*
Lanolin to D.T.D. 122C	30	30 parts by wt.
White spirit to B.S. 245 ...	65	70 „ „ „
3° Xylole to B.S. 458 ...	5	— „ „ „
Green dye (oil soluble) ...	1·5	— „ „ „

Characteristics: A thin soft film, which softens slightly on ageing, is left when the solvent evaporates. The green dye enables it to be seen more readily, but in the undyed variety it is omitted to obviate staining of operator's hands during application. The film does not withstand rubbing, hence treated articles should be wrapped, with the minimum of handling, in grease-resistant wrapping. Owing to the low melting point of lanolin (34–40°C; 95–105°F) PX–1 is unsuitable for high storage temperatures. The flash point of the solvent is about 100°F (38°C).

Method of Application: By dipping, spraying or brushing (solvent flammable); the film must be dry before wrapping.

Method of Removal: By solvents such as kerosine, white spirit or trichlorethylene, or by oils. Articles should be cleaned before use to remove grit or dirt but it is not otherwise necessary to remove the film since it will dissolve in lubricating oil.

Uses: Short-term preservation at medium ambient ground temperatures. Protection of certain land engine cylinders, valve gear, etc., of complete engines; gun barrels of A.A. guns in indoor storage. Also for preservation of ferrous and light alloy sheets in storage.

Alternatives:

Acceptable products

U.S. MIL–C–16173B Am. 1 Grade 2
Canadian 31–GP–3

Stores Numbers:

Dyed Grade

Nato Code No.	*Joint Service Catalogue No.*	*Package*	*Navy*	*Army*	*R.A.F.*
C–614	8030–99–943–1318	1 quart	0442/9431318	—	—
	8030–99–910–0478	1 gal	34B/9100478	HI/9100478	34B/9100478
	8030–99–910–0479	5 gal	—	HI/9100479	34B/9100479

Undyed Grade

Pending

PX-2

(Composition Rust Preventive)

Specification: C.S. 1033G.

Composition:

Bitumen Oxidised No. 1	31 parts by weight
Dehydrated Castor Oil	2 parts by weight
Zinc Naphthenate	2 parts by weight.
Naphtha, Coal Tar	17 parts by weight
Trichlorethylene	48 parts by weight.

Characteristics: A thin, black, tough, slightly tacky film, capable of being handled and resistant to rubbing is left when the solvent evaporates.

Method of Application: By dipping, spraying or brushing. The precautions usual when using trichlorethylene must be observed; these include adequate ventilation and no smoking. The film must be dry before wrapping, which is necessary mainly to protect it from mechanical damage especially at points of contact with the container. For long storage of highly finished surfaces under tropical conditions a moisture vapour proof barrier must be used in addition. To maintain the correct composition and consistency of dipping baths, thinners for Composition, Rust Preventive, C.S. 2275A, H.A. 13503 should be used.

Method of Removal: By common solvents such as kerosine, white spirit or diesel fuel. Particular care should be taken to see that small holes such as oilways are clear. Removal is facilitated by warming the articles.

Uses: Preservation of single components, tools and spares for MT and small arms. Unsuitable for internal use in engines, for sub-assemblies employing moving parts, or for parts with inaccessible recesses.

Alternatives:

Related products

U.S. MIL-C-16173B Am. 1. Grade 1
Canadian 31-GP-1

Stores Numbers:

Nato Code No.	*Joint Service Catalogue No.*	*Package*	*Navy*	*Army*	*R.A.F.*
—	8030-99-943-1319	1 gal	0442/9431319	—	—
	8030-99-910-0480	5 gal	—	HI/9100480	—

PX-3

(Pigmented Lanolin-Resin Solution)

Specification: D.T.D. 279B.

Composition:

Lanolin	6 lb.
Resin	4 lb.
Zinc Chrome	5 lb.
Kaolin	4 lb.
Petroleum spirit (boiling range 100°–120°C	8 pints
Xylole	2 pints.

Characteristics: A bright yellow pigmented preservative, the zinc chrome giving added protective properties and the kaolin serving as an extender. On evaporation of the solvent it yields a hard, slightly brittle film, capable of being handled and resistant to rubbing. The flash-point of the solvent being below 73°F, it is classed as dangerously flammable. PX–9 is substantially the same protective without pigments.

Method of Application: By dipping or brushing (solvent highly flammable). Must not be sprayed as zinc chrome is toxic.

Method of Removal: By common solvents such as kerosine or white spirit. With age the film becomes somewhat harder. Removal is facilitated by warming.

Use: Long-term preservation at medium and high ambient temperatures, particularly of steel and light-alloy sheeting and tubing, joints between dissimilar metals, internal metal surfaces of aircraft main-planes. Not recommended for low temperatures (say, below 15°F.) owing to embrittlement of the film.

Alternatives:

Acceptable product

U.S. MIL–C–16173B Am. 1 Grade I

Emergency substitute

Canadian 31–GP–1

Stores Numbers:

Nato Code No.	*Joint Service Catalogue No.*	*Package*	*Navy*	*Army*	*R.A.F.*
C–618	8030–99–910–0482	1 gal	0442/9100482	—	—
	8030–99–910–0483	5 gal	—	—	34B/9100483

PX-4

Specifications: DEF–2332.

Composition: Light mineral lubricating oil blended with a corrosion inhibitor.

Characteristics: Gives a thin, oily film. Is designed for unexposed internal surfaces where a thick-film cannot be applied or where the solvent of PX–1 would not evaporate or would be harmful.

Method of Application: By spraying, brushing, rinsing or dipping.

Method of Removal: By solvents, but removal is seldom necessary.

Uses: Protection of engine cylinders; gearboxes, back axle assemblies, etc., light machinery and instruments, carburettors, oil units, petrol pumps, sewing machines, etc.,; small articles such as nuts, screws, washers, etc., interim protection of certain ammunition and fuze components.

Alternatives:

Related products

U.S. MIL–L–21260, Grade 1 or 2 (for engine components)
MIL–L–3150 (for general purposes)
Canadian 3–GP–367a

Stores Numbers:

Nato Code No.	*Joint Service Catalogue No.*	*Package*	*Navy*	*Army*	*R.A.F.*
—	8030–99–943–1320	1 gal	0442/9431320	—	—
	8030–99–910–0484	5 gal	—	HI/9100484	34D/9100484

PX-6

(Mineral Jelly, High Melting Point)

Specifications: DEF–2333 (Includes PX–7).

Composition: A stiff, rather tacky petrolatum.

Characteristics:

Penetration (un-worked)	100 to 150
Viscosity when melted at 200°F ...	20 to 30 cS.
Drop point, min.	60°C (140°F)
Flash point, closed, min.	204°C (400°F)

Uses: Ingredient of PX–11; external protection of torpedoes.

Stores Numbers:

Nato Code No.	*Joint Service Catalogue No.*	*Package*	*Navy*	*Army*	*R.A.F.*
—	8030–99–910–0601	¼ lb	—	HI/9100601	—
	8030–99–943–1548	7 lb	0474/9431548	—	—
	8030–99–910–0485	28 lb	0474/9100485	HI/9100485	34D/9100485

PX-7

(Petrolatum, Soft)

Specifications: DEF–2333 (Includes PX–6).

Composition: A soft petrolatum.

Characteristics:

Penetration (worked)	230–275
Melting point, min.	40°C (104°F)
Flash point, min.	400°F (204°C)

Easier to apply than PX–6.

Method of Application: Brushing or smearing.

Method of Removal: By wiping, or by solvents such as kerosine or white spirit.

Uses: Protection of battery terminals and certain torpedo mechanisms.

Alternatives:

Standardised products

U.S. VV–P–236
Canadian 3–GP–665a

Stores Numbers:

Nato Code No.	*Joint Service Catalogue No.*	*Package*	*Navy*	*Army*	*R.A.F.*
S–743	8030–99–910–0488	4 oz tube	—	—	34B/9100488
	8030–99–910–0487	1 lb tin	(0474/9100487) (34B/9100487)	—	34B/9100487
	8030–99–943–2033	6 lb tin	—	RASC	—

PX-9

(Lanolin Resin Protective)

Specification: D.T.D. 663A.

Composition:

Lanolin	6 lb.
Resin	4 lb.
Petroleum spirit (boiling range 100–120°C.)	8 pints
Xylole	2 pints
Oil soluble red dye	$\frac{1}{3}$ oz.

Characteristics: On evaporation of the solvent PX–9 yields a transparent medium-hard film rendered easily visible by the red colouring. The flash-point of the solvent being below 73°F it is classed as dangerously flammable. PX–3 is substantially the same protective with pigment added.

Method of Application: Brush, dip or spray. Film must be dry before wrapping. Solvent highly flammable. If PX–9 be stored for any length of time below 50°F, it should be warmed and shaken to ensure homogeneity.

Method of Removal: By kerosine, white spirit, trichlorethylene, etc Removal is facilitated by warming the articles.

Uses: Preservation of aircraft spare parts, and certain medium calibre guns.

Alternatives:

Acceptable product

U.S. MIL–C–16173B Am. 1. Grade I

Stores Numbers:

Nato Code No.	*Joint Service Catalogue No.*	*Package*	*Navy*	*Army*	*R.A.F.*
C–629	8030–99–910–0489	5 gal	34B/9100489	—	34B/9100489

PX-10

Specification: C.S. 2060C.

Composition: Protective and surface-active materials dissolved in a volatile solvent.

Characteristics: A thin mobile liquid which displaces water (fresh or salt) from a metal surface. On evaporation of the solvent a protective film is left which prevents further rusting for a limited period of time. Recently wetted or already rusted surfaces can be treated. Water separates from the used fluid on standing, and the fluid can then be re-used. Like most oily substances, PX–10 causes swelling of natural rubber. Minimum flash point is 73°F (23°C.), and the average is well above this.

Method of Application: By dipping for small articles: by flushing for large assemblies (solvent flammable). Needless agitation, which hinders the settling of released water and tends to emulsify it, should be avoided.

Method of Removal: By kerosine, white spirit, etc. It is not generally necessary to clean off the film when a mechanism is re-filled with lubricating oil but any residue remaining will increase the tendency of the oil to emulsify with water.

Uses: Preliminary treatment of salvaged mechanisms and of articles degreased by alkali and water wash. Protection of water spaces of I.C. engines, of the cylinders and valve chests of steam engines, etc. Protection of impellers of certain gas turbines aircraft engines after vapour blasting.

Alternatives:

Related product

U.S. MIL–C–16173B, Grade 3

Stores Numbers:

Nato Code No.	*Joint Service Catalogue No.*	*Package*	*Navy*	*Army*	*R.A.F.*
—	8030–99–943–1321	1 quart	0442/9431321	—	—
	8030–99–943–1322	1 gal	0442/9431322	—	—
	8030–99–910–0491	5 gal	—	HI/9100491	34B/9100491

PX-11

Specifications: DEF–2334.

Composition:

Mineral jelly (PX–6)	90%
Beeswax	10%

Characteristics: Gives a thick, fairly firm greasy film, having a slightly higher melting point, better texture and better protective qualities than plain mineral jelly. Grease-resisting wrapping is necessary to protect the film from damage.

Method of Application: By hot dipping in melted material to give a film about 0·5 mm thick; the thickness may be controlled by the temperature and period of immersion. Parts should be wrapped only after the film has solidified.

Method of Removal: By kerosine, white spirit, etc. Meticulous cleaning is not necessary, since any residual material will disperse harmlessly in the lubricant, but freedom from grit and dirt should be ensured.

Uses: Preservation of M.T. and artillery equipment parts, such as piston assemblies, road springs and spring leaves, ball and roller bearings, oil seals; machine guns, rifles; gauges, adjustable spanners.

Alternatives:

Acceptable products

U.S. MIL–C–11796A Am. 1 Class 3
Canadian 31–GP–7

Stores Numbers:

Nato Code No.	*Joint Service Catalogue No.*	*Package*	*Navy*	*Army*	*R.A.F.*
C–628	8030–99–910–0492	7 lb	0474/9100492	HI/9100492	—
	8030–99–910–0493	14 lb	—	HI/9100493	—
	8030–99–910–0494	28 lb	0474/9100494	HI/9100494	34D/9100494
	8030–99–910–0495	56 lb	—	HI/9100495	—

PX-12

(Preservative for metal components containing rubber but see warning below under "Characteristics")

Specification: C.S. 2298D.

Composition:

Castor oil	...	...	...	...	75–85 parts by weight
Lead stearate	...	...	...	...	15–25 „ „ „
Oil-soluble purple dye	...	...	...		0·1 „ „ „

Characteristics:

Drop point, min. ... ... 65°C (149°F)

A soft, thick-film protective. Although this protective is less harmful to natural and synthetic rubbers than other surface metal protectives, no rubbers are completely unaffected if left in contact. In consequence, as little as possible of the protective should be allowed to come into contact with these materials. If, owing to the complexity of the items, some contact is unavoidable during preservation, the protective should be thoroughly removed from the rubber parts by the use of a clean dry rag as soon as possible after the preservation operation. Its use should be avoided on cadmium or lead coated surfaces or components containing copper alloys.

Method of Application: By brushing or smearing; also by hot dipping at about 100°C but the time of immersion must be kept short to guard against possible damage to the rubber parts.

Method of Removal: By wiping only, not by the use of solvent. Since the material has lubricating properties, cleaning is necessary only to the extent of removing grit or dirt.

Uses: Protection of bushes, engine mountings, components of hydraliuc equipment, etc., where these contain rubber inserts but within the limitations indicated above.

Stores Numbers:

Nato Code No.	*Joint Service Catalogue No.*	*Package*	*Navy*	*Army*	*R.A.F.*
—	8030–99–910–0496	7 lb	0474/9100496	HI/9100496	34D/9100496
	8030–99–942–8390	5 gal	—	HI/9428390	—

PX-13

(Engine Cylinder Protective, Wax Thickened)

Specification: D.T.D. 791B.

Composition:

Approved corrosion inhibitor	51 pts. by wt.
OM–270	153 „ „ „
Petroleum microcrystalline wax ...	64 „ „ „
Petroleum spirit (boiling range 30–160°C)	720 „ „ „
Approved dispersant additive	10 „ „ „
Approved tackiness additive	2 „ „ „

Characteristics: Gives a non-drying wax/oil film which does not drain from an inclined surface. The material is formulated to neutralise the corrosive effects of the combustion products of leaded fuel.

Method of Application: By spraying, brushing or dipping (solvent highly flammable).

Use: Preservation of aircraft engine cylinder bores, valves and springs, and cylinders and valve gears of Naval diesel engines.

Stores Numbers:

Nato Code No.	*Joint Service Catalogue No.*	*Package*	*Navy*	*Army*	*R.A.F.*
C–613	8030–99–910–0497	2 gal	0442/9100947	—	34B/9100497

PX-14

(Lanolised Oil)

Specification: D.T.D. 804. Am. 1.

Composition: Mineral oil containg 15% Lanolin.

Characteristics:

Viscosity at 70°F	210–250 cS
Pour point, max.	−10°F (−23°C)

Use: Preservation of light alloy sheets.

Stores Numbers:

Nato Code No.	*Joint Service Catalogue No.*	*Package*	*Navy*	*Army*	*R.A.F.*
—	8030–99–910–0498	4½ gal	—	—	34D/9100498

PX-15

(*Hot dipping strippable preservative*)

Specification: C.S. 2486A.

Composition: Heat-stabilized ethyl cellulose plus mineral and/or fatty oil together with plasticisers and suitable additives to improve stability and resistance to oxidation.

Characteristics: A tough transparent plastic material of high melting point. It does not adhere to metal. Metal objects properly cleaned and completely enveloped in PX–15 will remain fully protected for several years.

Method of Application: By hot-dipping in the melted material at approximately 190°C to give an unbroken coating about 2 mm thick. The thickness may be controlled by the temperature and period of immersion.

Method of Removal: By cutting and peeling off. The material can be melted and re-used but should be rejected as soon as excessive darkening or contamination is apparent.

Use: Protection of components, tools, cutting edges, etc., from corrosion and mechanical damage.

Stores Numbers:

Nato Code No.	*Joint Service Catalogue No.*	*Package*	*Navy*	*Army*	*R.A.F.*
—	8030–99–910–7062	56 lb keg.	0462/9107062	HI/9107062	33C/1251

PX-19

(*Soft film temporary protective*)

Specification: T.S. 325.

Composition: Mineral lubricating oil and calcium soaps.

Characteristics:

Penetration...	330 min.	360 max.
Drop point °C	80 min.	

The specification includes a test for oxidation stability and a performance test of effectiveness in protecting steel.

Use: As a temporary protective for steel parts, replacing LG–280 for this purpose.

Stores Numbers: Pending.

Other temporary protectives are listed under the designation:

OX–275, A storage oil for aircraft piston engines, page 32.
ZX–11, A white lead paste for buoys, etc., page 51.

Section V. Fuels

This section has not been arranged in a strictly alphabetical order as have the other sections for it is considered that the products which it covers would be more conveniently found if they were arranged in accordance with the uses for which they are intended. In consequence the following order has been adopted:—

1. Aviation fuels for piston and turbine engines, including starter (AVPIN) and rocket (H.T.P.) fuel.

2. Motor transport fuels for spark ignition and compression ignition engines.

3. Heating and steam raising fuels.

4. Reference fuels i.e. fuels used for type testing of engines and experimental purposes when it is necessary to use products with certain features more closely controlled than they are by the ordinary specifications.

AIRCARFT PISTON ENGINES

Grades 73, 100/130 *and* 115/145

Specification: D.Eng.R.D. 2485 Issue 3. Am. 1.

Composition: Hydrocarbons.

Characteristics: All three grades have the following characteristics in common:—

Distillation		
Fuel evaporated per cent at	75°C ...	10 min. 40 max.
	105°C ...	50 min.
	135°C ...	90 min.
F.B.P.		170°C max.
Sum of 10% and 50% evaporated points		135°C min.
Specific gravity		not limited
Sulphur total wt. %		0·05 max.
Vapour pressure, Reid		5·5 min. 7·0 max.

73 NL AVGAS

Special Characteristics:

Colour	Colourless
Knock rating. Lean mixture. Motor Method	73 min.
T.E.L. content ml/Imp. gal	zero

Uses: In certain small aircraft piston engines and for run-out of other engines, normally operating on leaded grades, prior to storage.

Stores Numbers:

Nato Code No.	*Joint Service Catalogue No.*	*Package*	*Navy*	*Army*	*R.A.F.*
F-13	9130-99-910-0447	Bulk	K/9100447	AAC	34A/9100447

100/130 AVGAS

Special characteristics:

Colour	Green
Knock rating	Lean 100 O.N. min. Rich 130 P.N. min.
T.E.L. content ml/Imp. gal.	5·5 max.

Uses: In most British aircraft piston engines and in certain engines in small marine craft. All engines cleared for 100/130 grade can use 115/145 grade if the former is not available.

Alternatives:

Standardised products

U.S. MIL–G–5572C Grade 100/130
Canadian 3–GP–25d Grade 100/130

Stores Numbers:

Nato Code No.	*Joint Service Catalogue No.*	*Package*	*Navy*	*Army*	*R.A.F.*
F–18	9130–99–910–0444	Bulk	K/9100444	AAC	34A/9100444

115/145 AVGAS

Special characteristics:

Colour	Purple
Knock rating	Lean 115 P.N. min. Rich 145 P.N. min.
T.E.L. content ml/Imp. gal.	5·5 max.

Use: In most U.S. aircraft piston engines.

Alternatives:

Standardised products

U.S. MIL–G–5572C Grade 115/145
Canadian 3–GP–25d Grade 115/145

Stores Numbers:

Nato Code No.	*Joint Service Catalogue No.*	*Package*	*Navy*	*Army*	*R.A.F.*
F–22	9130–99–910–0443	Bulk	—	—	34A/9100443

AVCAT/40

(Hight flash point fuel. Minus 40°C. freezing point)

Specification: D.ENG. R.D. 2488 Issue 3. Am. 1, 2 and 3.

Composition: Hydrocarbons.

Characteristics:

Aromatics % vol.	25 max.
Bromine No.	5 max.
Distillation:	
Fuel evaporated at 204°C%	10 min.
F.B.P.	288°C max.
Flash point (closed)	140°F min.
Freezing point ... ... minus	40°C max.
Specific gravity at 60°F	0·788 min. 0·845 max.
Sulphur total % wt.	0·40 max.
Viscosity cS at minus 30°F	16·5 max.

Uses: In R.N. carrier borne turbine engined aircraft. Being replaced by AVCAT/48.

Alternatives:

Related products

U.S. MIL-J-5624E JP-5
Canadian 3-GP-24c

Stores Numbers:

Nato Code No.	*Joint Service Catalogue No.*	*Package*	*Navy*	*Army*	*R.A.F.*
F-42	9130-99-910-0450	Bulk	K/9100450	—	—

AVCAT/48

(High flash point fuel. Minus 48°C freezing point)

Specification: D.ENG. R.D. 2498 Issue 1. Am. 1.

Characteristics: Almost identical with those of AVCAT/40 except for freezing point which is 8°C lower.

Uses: In R.N. carrier borne aircraft turbine engines. Will replace AVCAT/40.

Alternatives:

Standardised products

U.S. MIL-J-5624E JP-5
Canadian 3-GP-24c

Stores Numbers:

Nato Code No.	*Joint Service Catalogue No.*	*Package*	*Navy*	*Army*	*R.A.F.*
F-44	9130-99-220-2148	Bulk	K/2202148	—	—

AVTAG

(*Aviation turbine gasoline—wide cut gasoline*)

Specification: D.ENG. R.D. 2486 Issue 3. Am. 1 and 2.

Composition: Hydrocarbons.

Characteristics:

Aromatics % vol.	25 max.
Bromine No.	5 max.
Distillation:	
Fuel evaporated %	
at 143°C	20 min.
at 188°C	50 min.
at 243°C	90 min.
Freezing point	minus 60°C max.
Smoke volatility index	54 min.
Specific gravity at 60°F	0.751 min. 0·802 max.
Sulphur total % wt.	0·40 max.
Vapour pressure Reid	2 to 3 lb.

Uses: In Aircraft turbine engines for which it is the most widely used fuel. Not for use in R.N. carrier borne aircraft.

Alternatives:

Standardised products

U.S. MIL-J-5624E JP-4
Canadian 3-GP-22d

Stores Numbers:

Nato Code No.	*Joint Service Catalogue No.*	*Package*	*Navy*	*Army*	*R.A.F.*
F-40	9130-99-910-0448	Bulk	—	+	34A/9100448

AVTUR/40

OBSOLESCENT

Being replaced by AVTUR/50.

AVTUR/50

(Kerosine type. Minus 50°C freezing point)

Specification: D. ENG. R.D. 2494. Issue 2.

Composition: Hydrocarbons.

Characteristics:

Aromatics % vol.	20 max.
Bromine No.	5 max.
Distillation: ...	
Revovery at 200°C %	20 min.
F.B.P.	300°C max.
Flash point (Abel)	100°F min.
Freezing point	minus 50°C max.
Specific gravity at 60°F	0·775 min. 0·825 max.
Sulphur total % wt.	0·20 max.
Viscosity cS at 0°F	6 max.

Uses: In aircraft turbine engines. Mostly where AVTAG is not available, e.g. Middle East. Not for use in R.N. carrier borne aircraft.

Alternatives:

Standardised product	*Emergency substitutes*
Canadian 3-GP-23d	U.S. MIL-J-5624E JP-4 and JP-5

Stores Numbers:

Nato Code No.	*Joint Service Catalogue No.*	*Package*	*Navy*	*Army*	*R.A.F.*
F-34	9130-99-943-1771	Bulk	K/9431771	—	34A/9431771

AVPIN

Specification: D. Eng. R.D. 2492 Issue 2.

Composition: Isopropyl nitrate.

Characteristics: A very pure product is required consequently very low limits are specified for acidity, chlorides, nitrates and sulphates.

Dissolved water	0·12% wt. max.
Specific gravity at 60°F	1·047 min.

Uses: In turbine engine combustion starters.

Stores Numbers:

Nato Code No.	*Joint Service Catalogue No.*	*Package*	*Navy*	*Army*	*R.A.F.*
S-746	9130-99-942-3147	40 gal	34A/9423147	—	34A/9423147

H.T.P. (High Test Peroxide) Type A

Specification: C.S. 5343.

Composition: A clear solution of hydrogen peroxide in water.

Characteristics:

Hydrogen peroxide % wt.	80 min.
Stabiliser (sodium stannate) mg./litre ...	2·5 min. 6·5 max.
Anti-corrosion agent (ammonium nitrate) mg/l	10 min. 30 max.

The specification includes a stability test and limits the following possible impurities, i.e. chlorides, sulphates, phosphates and carbon.

Uses: In certain rocket engines.

Stores Numbers:

Nato Code No.	*Joint Service Catalogue No.*	*Package*	*Navy*	*Army*	*R.A.F.*
—	6810-99-942-3218	Bulk	K/9423218	—	34A/9423218

Rocket Fuel Kerosine Type

Specification: D. Eng. R.D. 2495 Issue 1. Am. 1.

Composition: A high grade kerosine with very low aromatic content and narrow specific gravity range.

Characteristics:

Aromatics % vol.	5 max.
Bromine No.	1 max.
Distillation:	
10% recovery °C	170 min. 200 max.
F.B.P. °C	270 max.
Flash point (Abel) °F	110 min.
Freezing point	minus 40°F max.
Smoke point mm.	35 min.
Specific gravity at 60°F	0·778 min. 0·786 max.
Sulphur total % wt.	0·05 max.
Viscosity cS at 0°F	6 max.

Uses: In certain rocket engines.

Stores Numbers:

Nato Code No.	*Joint Service Catalogue No.*	*Package*	*Navy*	*Army*	*R.A.F.*
—	—	Bulk	—	—	+

GASOLINES

74 MTGAS

Specification: DEF-2401-B. (Includes 80 MTGAS and 80/Z MTGAS).

Composition: Hydrocarbons.

Characteristics:

Colour	Yellow
Distillation:	
10% evaporated at °C	70 max.
50% „ „ „	125 max.
90% „ „ „	180 max.
F.B.P. °C	205 max.
either octane No. M.M.	74 min.
or „ „ R.M.	79 min.
Sulphur total % wt.	0·25 max.
T.E.L. content ml/Imp. gal	1·8 max.
Vapour pressure, Reid	9 lb. max. (In temperate climates 11 lb. max. is permitted).

Uses: In the majority of non-armoured vehicle engines and for certain electric generating equipment.

Stores Numbers:

Nato Code No.	*Joint Service Catalogue No.*	*Package*	*Navy*	*Army*	*R.A.F.*
F–50	9130–99–910–0453	Bulk	K/9100453	RASC	34C/9100453

80 MTGAS

Specification: DEF-2401-B. (Includes 74 MTGAS and 80/Z MTGAS).

Composition: Hydrocarbons.

Characteristics:

Colour	Red
Distillation:	
10% evaporated at °C	60 min. 70 max.
50% „ „ „	88 min. 115 max.
90% „ „ „	132 min. 180 max.
F.B.P. °C	205 max.
Octane No. M.M.	80 min.
„ „ R.M.	86 min.
Sulphur total % wt.	0·25 max.
T.E.L. content	3·6 max.
Vapour pressure, Reid	8 lb. max.

Uses: In armoured and certain non-armoured vehicle engines and A.O.P. aircraft engines.

Alternatives:

Standardised products
U.S. MIL–G–3056B Am. 1
Canada 3–GP–7c Type 1

Stores Numbers:

Nato Code No.	*Joint Service Catalogue No.*	*Package*	*Navy*	*Army*	*R.A.F.*
F–46	9130–99–910–0451	Bulk	—	RASC	34C/9100451

80/Z MTGAS

Specification: DEF-2401-B. (Includes 74 MTGAS and 80 MTGAS).

Composition: Hydrocarbons.

Characteristics:

Colour	Red
Cold test (freezing point) °C ...	Minus 60 max.
10% evaporated at °C	50 max.
50% ,, ,, ,, ...	95 max.
90% ,, ,, ,, ...	150 max.
F.B.P. °C	205 max.
Octane No. M.M.	80 min.
,, ,, R.M.	86 min.
Sulphur total % wt.	0·25 max.
T.E.L. content ml/Imp. gal	3·6 max.
Vapour pressure, Reid	12 lb. min. 14 lb. max.

Use: In armoured and non-armoured vehicle engines in very cold climatic conditions.

Alternatives:

Standardised products

U.S. MIL–G–3056B Am. 1
Canada 3–GP–7c Type 2 Am. 1

Stores Numbers:

Nato Code No.	*Joint Service Catalogue No.*	*Package*	*Navy*	*Army*	*R.A.F.*
F–48	9130–99–910–0452	Bulk	—	RASC	—

VAPO

Specification: DEF–2404.

Composition: Hydrocarbons (vaporising oil)

Characteristics:

Cold test (freezing point) °C ...	Minus 50 max.
Distillation	
Recovery at 160°C %	5 min.
„ „ 200°C %	50 min.
F.B.P. °C	275 max.
Flashpoint (Abel) °F	90 min.
Octane number M.M.	45 min.
Sulphur total % wt.	0·5 max.

Uses: In vaporizing oil engines and as a diluent of lubricating oils for use at very low temperatures. The latter use is decreasing with the introduction of suitable low temperature oils.

Stores Numbers:

Nato Code No.	*Joint Service Catalogue No.*	*Package*	*Navy*	*Army*	*R.A.F.*
—	9140–99–910–0455	Bulk	—	RASC	34C/9100455

47/20 DIESO

Specification: DEF-2402-A. (Includes 47/20/MT, 47/0 and 45/-30 DIESO).

Composition: Hydrocarbons.

Characteristics:

Cetane No....	47 min.
Distillation:	
90% recovery at °C	357 max.
F.B.P. °C	385 max.
Flash point, closed °F	150 min.
Pour point °F	20 max.
Sulphur total % wt.	1·0 max.

Uses: In compression ignition engines, mainly of high and medium speed type, at medium and high ambient temperatures. Also in gas turbine engines in certain Naval helicopters.

Alternatives:

Acceptable products

U.S. MIL–F–16884c (Ships) Am. 1. Type 1.
Canadian 3–GP–15b Types 1 and 11

Stores Numbers:

Nato Code No.	*Joint Service Catalogue No.*	*Package*	*Navy*	*Army*	*R.A.F.*
F–79	9140–99–942–3220	Bulk	+	RASC	34C/9423220

47/20 DIESO /MT)

This is identical with 47/20 DIESO but is only for use in road vehicle engines where it is subject to excise duty.

Specification: DEF-2402-A. (Includes 47/20, 47/0 and 45/-30 DIESO).

Stores Numbers:

Nato Code No.	*Joint Service Catalogue No.*	*Package*	*Navy*	*Army*	*R.A.F.*
F–79	9140–99–910–0459	Bulk	K/9100459	RASC	34C/9100459

47/0 DIESO

Specification: DEF-2402-A. (Includes 47/20, 47/20/MT and 45/-30 DIESO).

Composition: Hydrocarbons.

Characteristics: Specification requirements are identical with those of 47/20 DIESO except for cloud and pour points which are 20°F lower in each case.

Uses: In compression ignition engines mainly of high and medium speed type at all temperatures except very low.

Alternative:

Acceptable product

U.S. MIL–F–16884c (Ships) Am. 1 Type 1

Stores Numbers:

Nato Code No.	*Joint Service Catalogue No.*	*Package*	*Navy*	*Army*	*R.A.F.*
F–78	9140–99–910–0458	Bulk	—	RASC	—

45/-30 DIESO

Specification: DEF-3402-A. (Includes 47/20, 47/20/MT and 47/0 DIESO).

Composition: Hydrocarbons.

Characteristics:

Cetane No....	45 min.
Distillation:	
90% recovery at °C	316 max.
F.B.P. °C	343 max.
Flash point, closed °F	100 min.
Pour point °F	minus 30 max.
Sulphur total % wt.	1·0 max.

Uses: In compression ignition engines of all types at very low temperatures and in certain heating and electric generating equipment.

Stores Numbers:

Nato Code No.	*Joint Service Catalogue No.*	*Package*	*Navy*	*Army*	*R.A.F.*
—	9140–99–910–5052	Bulk	—	RASC	+

COLD STARTING FUEL DIESEL ENGINE

(Volatile ignition promoting fluid)

Specification: T.S. 333.

Composition:

Diethyl ether (B.S. 579)	70·0% vol.
Petroleum ether 100°/120°C (DEF-2407)	24·0% „
Methanol (B.S. 506)	20.% „
Insulating oil (B.S. 148)	4·0% „

Characteristics:

Distillation:	
I.B.P. °C	36 ± 2
10% evaporated °C	38 ± 2
50% „ „	44 ± 2
80% „ „	108 ± 2
Specific gravity at 60°F	0·728 min. 0·735 max.

Use: For starting diesel engines when the ambient air temperature is 40°F or lower.

Stores Numbers: Pending.

3/50 FFO

Specification: DEF–2406 (Includes grades 36/50, 50/50, 75/50 and 125/50).

Composition: Hydrocarbons.

Characteristics:

Ash % wt.	0·01 max.
Carbon residue, Couradson % wt. ...	0·2 max.
Flash point, Pensky-Marten °F ...	130 min.
Pour point °F	20 max.
Sulphur total % wt.	2·0 max.
Viscosity cS at 100°F	7·5 max.

Uses: In small automatic burners for domestic and other purposes that require a distillate fuel. Does not require heated storage in temperate climates.

Stores Numbers:

Nato Code No.	*Joint Service Catalogue No.*	*Package*	*Navy*	*Army*	*R.A.F.*
—	9140–99–943–3330	Bulk	+*	RASC	34C/9433330

*Used by the R.N. for non-marine purposes only.

36/50 FFO

Specification: DEF–2406 (Includes grades 3/50, 50/50, 75/50 and 125/50).

Composition: Hydrocarbons.

Characteristics:

Flash point, Pensky-Marten °F ...	150 min.
Sulphur total % wt.	3·5 max.
Viscosity cS at 122°F	36 max.

Uses: In steam raising and certain heating and electric generating plants when a Redwood 250 seconds at 100°F fuel is required. May require heated storage in temperate climates. Not for use in H.M. ships.

Stores Numbers:

Nato Code No.	*Joint Service Catalogue No.*	*Package*	*Navy*	*Army*	*R.A.F.*
—	9140–99–910–0464	Bulk	+*	RASC	34C/9100464

* Used by the R.N. for non-marine purposes only.

50/50 FFO

Specification: DEF–2406 (Includes grades 3/50, 36/50, 75/50 and 125/50).

Composition: Hydrocarbons.

Characteristics:

Ash % wt.	... ...	0·1 max.
Explosivity %	... ...	50 max.
Flash point, Pensky-Marten °F	...	150 min.
Sulphur total % wt.	... ...	3·5 max.
Viscosity cS, at 122°F	... ...	11·8 min. 48·6 max.

A special test is included to ensure that the fuel is pumpable under storage conditions.

Uses: Firing boilers in H.M. Ships.

Alternatives:

Standardised product
Canadian 3–GP–12c

Acceptable product
U.S. MIL–F–859D Am. 2 Type special

Stores Numbers:

Nato Code No.	*Joint Service Catalogue No.*	*Package*	*Navy*	*Army*	*R.A.F.*
F–77	9140–99–943–3269	Bulk	+	—	—

75/50 FFO

Specification: DEF–2406 (Includes grades 3/50, 36/50, 50/50 and 125/50).

Composition: Hydrocarbons.

Characteristics:

Ash % wt.	... ...	0·1 max.
Explosivity %	... ...	50 max.
Flash point, Pensky-Marten °F	...	150 min.
Sulphur total % wt.	... ...	3·5 max.
Viscosity	... ...	11·8 min. 75 max.

A special test is included to ensure that the fuel is pumpable under storage conditions.

Uses: Firing boilers in H.M. Ships and in certain heating and electric generating equipment.

Alternatives:

Acceptable product
Canadian 3–GP–12c

Emergency substitute
U.S. MIL–F–859D Am. 2. Type special

Stores Numbers:

Nato Code No.	*Joint Service Catalogue No.*	*Package*	*Navy*	*Army*	*R.A.F.*
F–84	9140–99–910–0463	Bulk	+	—	—

125/50 FFO

Specification: DEF-2406 (Includes grades 3/50, 36/50, 50/50 and 75/50).

Composition: Hydrocarbons.

Characteristics:

Flash point, Pensky-Marten °F ...	150 min.
Sulphur total %wt.	4·5 max.
Viscosity cS at 122° F	150 max.

Uses: In steam raising and certain heating plants when a Redwood 1000 seconds at 100°F fuel is required. Will require heated storage in temperate climates. Not for use in H.M. Ships.

Stores Numbers:

Nato Code No.	*Joint Service Catalogue No.*	*Package*	*Navy*	*Army*	*R.A.F.*
—	9140-99-942-5615	Bulk	+*	RASC	34C/9425615

*Used by the R.N. for non-marine purposes only.

3,500 Seconds FFO

Specification: B.S. 2869 Class G.

Composition: Hydrocarbons.

Characteristics:

Viscosity at 100°F	3,500 R.S. max.
„ „ 50°C (122°F)	370 cS max.

Uses: In certain steam raising and heating plants where a very heavy fuel is required. Will need heated storage in temperate climates. Not for use in H.M. Ships.

Stores Numbers:

Nato Code No.	*Joint Service Catalogue No.*	*Package*	*Navy*	*Army*	*R.A.F.*
—	9140-99-942-6256	Bulk	—	—	34C/9426256

KERO/A

Specification: DEF-2403. (Includes KERO/B).

Composition: Hydrocarbons (Kerosine).

Characteristics:

Char value mg/kg	10 max.
Distillation	
Recovery at 200°C %	15 min.
F.B.P. °C	300 max.
Flash point (Abel) °F	115 min.
Smoke point mm.	35 min.
Sulphur total % wt.	0·06 max.

Uses: Heating and lighting in confined spaces particularly for wick-fed burners.

Stores Numbers:

Nato Code No.	*Joint Service Catalogue No.*	*Package*	*Navy*	*Army*	*R.A.F.*
—	9140–99–910–5053	Bulk	0442/10596	RASC	34C/9105053

KERO/B

Specification: DEF-2403. (Includes KERO/A).

Composition: Hydrocarbons (Kerosine).

Characteristics:

Char value mg/kg	20 max.
Distillation:	
Recovery at 200°C %	15 min.
F.B.P. °C	300 max.
Flash point (Abel) °F	100 min.
Smoke point mm.	25 min.
Sulphur total % wt.	0·2 max.

Uses: Heating, lighting and cleaning.

Alternatives:

Standardised products

U.S. VV–K–211C Am. 1
Canadian 3–GP–3 Type 1

Stores Numbers:

Nato Code No.	*Joint Service Catalogue No.*	*Package*	*Navy*	*Army*	*R.A.F.*
F–58	9140–99–910–5054	Bulk	0442/10595	RASC	34C/9105054

NLGAS

Specification: Detailed in the contract document.

Composition: Lead free gasoline.

Characteristics:

Distillation:	
10% evaporated at °F	158 max.
50% " " "	257 max.
90% " " "	356 max.
Octane No. M.M.	67 min.
Sulphur total % wt.	0·25 max.
T.E.L. content	Nil
Vapour pressure, Reid	10 lb max.

Uses: In gasoline fuelled heating and lighting equipment, also for cleaning purposes. Is suitable for use in certain low compression ratio motor vehicle and stationery spark ignition engines.

Stores Numbers:

Nato Code No.	*Joint Service Catalogue No.*	*Package*	*Navy*	*Army*	*R.A.F.*
—	9130-99-910-0454	Bulk	+	—	34C/9100454

PETROLEUM SPIRIT, 100/120°C. BOILING RANGE

Specification: DEF–2407.

Composition: Hydrocarbons.

Characteristics:

Aromatics % vol.	15 max.	
Bromine No.	3 max.	
Distillation:		
I.B.P. °C	98 min.	105 max.
F.B.P. °C	112 min.	122 max.
% distilled to 110°C	50 min.	80 max.
Specific gravity at 60°F ...	...0·730 min.	0·755 max.

Use: As a solvent.

Stores numbers:

None.

REFERENCE FUELS

These fuels are intended for use in air, land and marine engines where tests (e.g. type tests) are carried out to assess the performance of such engines or engine fuel system components on Service fuels and lubricants.

In general each fuel complies with all the requirements of the appropriate normal Service grade but the specifications include additional requirements to ensure that those fuel features, which engines find it most difficult to tolerate, are present to an extent approaching the upper limits set by the Service specifications e.g. The Service specification for 80 MTGAS (DEF–2401–B) sets an upper limit to T.E.L. content at 3·6 ml./I.G. but normal peace time supplies seldom contains as much as 2 ml./I.G. The reference fuel, however, must contain between 3·4 and 3·6 ml./I.G.

These reference fuels are not strictly Service ones but they have been included since they are of major interest to engine and equipment manufacturers and to Experimental Establishments. Some only are stocked by the Services and, since they have no stores numbers reference is made under each product to their "Source of Supply".

AIRCRAFT TURBINE ENGINE AVTAG TYPE

Specifications: R.D.E./F/KER/210. Issue 3.

Composition: Hydrocarbons.

Characteristics: Must meet all the requirements of the AVTAG specification D. Eng. R.D. 2486 with the exception of aromatics and total sulphur where the following limits apply :—

Aromatics % vol.	15 min.	25 max.
Sulphur total % wt.	0·2 min.	0·4 max.

Uses: For type testing and certain development running of aircraft turbine engines.

Source of Supply: Major fuel companies.

74 OCTANE. LOW VAPOUR PRESSURE (MT)

Specification: DEF-2405-A Am 1. Includes all M.T. and Diesel Reference Fuels.

Composition: Hydrocarbons.

Characteristics:

Colour	Yellow
Distillation:	
10% evaporated at °C	65 ± 10
50% „ „ „	110 ± 10
90% „ „ „	170 ± 10
F.B.P. °C	195 ± 10
Octane No. M.M.	74 min. 76 max.
„ „ R.M.	79 „ 81 „
Sulphur total % wt.	0·25 max.
T.E.L. content, ml/Imp. gal	1·5 min. 1·8 max.
Vapour pressure. Reid	8·0 min. 10·0 max.

Uses: In type and development testing of the majority of non-armoured vehicle engines and for certain electric generating units particularly where vapour pressure is an important factor.

Source of Supply: Refer to F.V.A. 3 War Office.

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74 OCTANE. HIGH VAPOUR PRESSURE (M.T.)

Specification: DEF-2405-A Am. 1. Includes all M.T. and Diesel Reference Fuels.

Composition: Hydrocarbons.

Characteristics:

Colour	Yellow
Distillation:	
10% evaporated at °C	55 ± 10
50% „ „ „	105 ± 10
90% „ „ „	180 ± 10
F.B.P. °C	195 ± 10
Octane No. M.M.	74 min. 76 max.
„ „ R.M.	79 min. 81 max.
Sulphur total % wt.	·025 max.
T.E.L. content, ml/Imp. Gal	1·5 min. 1·8 max.
Vapour pressure Reid	10·0 min. 12·0 max.

Uses: In type and development testing in the majority of non-armoured vehicle engines and for certain electric generating units, particularly where vapour pressure is an important factor.

Source of supply: Refer to F.V.A. 3, War Office.

80 OCTANE (M.T.)

Specification: DEF-2405-A Am. 1. Includes all M.T. and Diesel Reference Fuels.

Composition: Hydrocarbons.

Characteristics:

Colour	Red
Distillation	
10% evaporated at °C	65 ± 5
50% „ „ „	105 ± 10
90% „ „ „	170 ± 10
F.B.P. °C	195 ± 10
Octane No. M.M.	80 min. 82 max.
„ „ R.M.	86 „ 88 „
Sulphur total % wt.	0·10 min. 0·25 max.
T.E.L. content ml/Imp. gal	3·4 min. 3·6 max.
Vapour pressure. Reid	7·0 min. 9·0 max.

Uses: In type and development testing in armoured and certain non-armoured vehicle engines and A.O.P. aircraft engines, particularly where T.E.L. content is an important factor.

Source of supply: Refer to F.V.A. 3, War Office.

HIGH SULPHUR (DIESEL FUEL)

Specification: DEF-2405-A Am. 1. Includes all M.T. and Diesel Reference Fuels.

Composition: Hydrocarbons.

Characteristics:

Cetane No.	47 min. 60 max.
Distillation:	
50% recovery at °C	245 min.
90% „ „ „	357 max.
F.B.P. °C	385 max.
Flash point, closed °F	150 min.
Pour point °F	20 max.
Sulphur total % wt.	0·9 min. 1·0 max.

Uses: In type and development testing of compression ignition engines, mainly of high and medium speed type, and in gas turbine engines in certain Naval helicopters particularly where sulphur content is an important factor.

Source of supply: Refer to F.V.A. 3, War Office.

47 CETANE (DIESEL FUEL)

Specification: DEF-2405-A. Am. 1. Includes all M.T. and Diesel Reference Fuels.

Composition: Hydrocarbons

Characteristics:

Cetane No....	45 min.	50 max.
Distillation: ...		
90% recovery at °C		357 max.
F.B.P. °C		385 max.
Flash point, closed °F	150 min.	
Pour point °F		20 max.
Sulphur total % wt.		1·0 max.

Uses: In type and development testing of compression ignition engines, mainly of high and medium speed type, and in gas turbine engines of certain Naval helicopters, particularly where cetane number is an important factor.

Source of supply: Refer to F.V.A. 3, War Office.

LOW TEMPERATURE (DIESEL FUEL)

Specification: DEF-2405-A Am. 1. Includes all M.T. and Diesel Reference Fuels.

Composition: Hydrocarbons.

Characteristics:

Cetane No.	37 min.	43 max.
Cloud point °F	−34 min.	−26 max.
Distillation:		
90% recovery at °C		316 max.
F.B.P. °C		343 max.
Flash point, closed °F	100 min.	
Pour point °F		minus 40 max.
Sulphur total % wt.		1·0 max.
Viscosity cS at 100°F	1·4 min.	

Uses: In type and development testing of compression ignition engines, mainly of high and medium speed type and in gas turbine engines of certain Naval helicopters where ability to flow at very low temperatures is an important factor.

Source of supply: Refer to F.V.A. 3, War Office.

Section VI. Miscellaneous Fluids

AL-3

(Engine Coolant)

Specification: B.S. 3150 Type A.

Composition: Ethylene glycol inhibited with triethanolamine phosphate and sodium mercaptobenzothiazole and dyed with sodium fluorescein.

The following table shows the approximate freezing point (temperature for the first appearance of ice crystals) of solutions of ethylene glycol and water of various concentrations:

Glycol % Vol.	Freezing Point °F	°C
10	26	−3·3
15	22	−5·5
20	16	−8·9
25	10	−12·2
30	3	−16·1
35	−5	−20·6
40	−12	−24·4
45	−22	−30
50	−33	−36·1

Use: As an anti-freeze agent in liquid cooled aircraft and land transport engines. Generally added in the proportion of 30 parts by volume to 70 parts of water.

Alternatives:

Standardised products

U.S. MIL-E-5559
Canadian 3-GP-850a

Stores Numbers:

Nato Code No.	*Joint Service Catalogue No.*	*Package*	*Navy*	*Army*	*R.A.F.*
S-735	6850-99-910-0469	45 gal	E6/9100469	—	—
	6850-99-910-0470	5 gal	34B/9100470	—	34B/910047
	6850-99-943-7237	4½ gal	—	RASC	—

AL-14

Specification: B.S. 506.

Composition: Methanol (methyl alcohol).

Characteristics:

Distillation. Not less than 95% shall distil between	64·5°C and 65.5°C
Specific gravity at 60°F	0·7990 max.
Sulphur total % wt.	0·05 max.

Use: Anti-freeze for certain pneumatic systems.

Alternatives:

Related products

U.S. O–M–232b Grade A
Canadian do.

Stores Numbers:

Nato Code No.	*Joint Service Catalogue No.*	*Package*	*Navy*	*Army*	*R.A.F.*
—	6850–99–910–5063	1 gal	34B/9105063	—	34B/9105063

AL-23

Specification: C.S. 1485.

Composition: Diethylene glycol mono-butyl ether.

Characteristics:

Specific gravity at 20°C/20°C	0·955 min. 0·965 max.
Distillation:	
First drop °C	215 min.
95% recovery °C	220 min. 235 max.
Sulphates (as Na_2SO_4) % wt.	0·05 max.
Chlorides (as NaCl) % wt.	0·05 max.

Very low limits are specified for acidity or alkalinity.

Use: As a coolant for certain radar equipment.

Stores Numbers:

Nato Code No.	*Joint Service Catalogue No.*	*Package*	*Navy*	*Army*	*R.A.F.*
—	6810–99–942–8472	50 ml. bottle	—	—	34D/9428472

AL-26

Specification: T.S. 331A.

Composition:

Ethylene glycol (B.S. 2537)	61.5% by wt.
Water (distilled B.P.)	37% „ „
Sodium benzoate (B.S. 3151)	1·5% „ „
Red dye as required.	

Characteristics:

Specific gravity at 60°F	1·08 min.	1·09 max.
pH value	7·0 min.	8·0 max.
Freezing point of 50% vol. solution in water. °C.		−15 max.

Uses: As a Coolant in certain radio equipment.

Stores Numbers: Pending.

AL-27

Specification: T.S. 337.

Composition:

Ethylene glycol	61·5% by wt.
Water (distilled)	36·9% „ „
Sodium benzoate	1·5% „ „
„ nitrite	0·1% „ „
Blue dye as required.	

Characteristics: Essentially the same as AL–26 except for the presence of 0·1% of sodium nitrite and for the colour which is blue instead of red.

Use: As a coolant for certain radio equipment.

Stores Numbers: Pending.

AL-17

Specification: C.S. 2908.

Composition:

Glycerine	60 parts
Water	40 „
Sodium Nitrite	0·2 „
Disodium Hydrogen phosphate ...	1·0 „

Use: As an hydraulic fluid in certain gun equipment.

Stores Numbers:

Nato Code No.	*Joint Service Catalogue No.*	*Package*	*Navy*	*Army*	*R.A.F.*
—	9150-99-942-6280	5 gal	—	H1/9426280	34D/9426280

AL-5

Specification: D.T.D. 406 B.

Composition:

	Ethylene glycol to B.S. 2537	85% by vol.
either	Ethanol to DEF–58	5% „ „
or	Isopropanol to B.S. 1595	5% „ „
	Water	10% „ „

Uses: In propeller and wing and tail de-icing systems with porous distributors.

Stores Numbers:

Nato Code No.	*Joint Service Catalogue No.*	*Package*	*Navy*	*Army*	*R.A.F.*
S–745	6850–99–910–0472	5 gal	34B/9100472	—	34B/9100472

AL-6

Specification: D.T.D. 900/4031.

Composition: Proprietary.

Use: Removal of hoar frost from parked aircraft.

Alternative:

Acceptable product

U.S. MIL–A–8243 (USAF) Am. 1

Stores Numbers:

Nato Code No.	*Joint Service Catalogue No.*	*Package*	*Navy*	*Army*	*R.A.F.*
S–739	6850–99–910–0473	5 gal	34B/9100473	AAC	34B/9100473

AL-7

Specification: D.T.D. 900/4050.

Composition: Proprietary.

Use: Aircraft de-icing in Dunlop equipment.

Stores Numbers:

Nato Code No.	*Joint Service Catalogue No.*	*Package*	*Navy*	*Army*	*R.A.F.*
—	6850–99–910–0474	5 gal	34B/9100474	—	34B/9100474

AL-8

Specification: DEF–58.

Composition: Industrial methylated spirit, 68.O.P. Ethanol 68.O.P. denatured by addition of 5 per cent of wood naphtha.

Use: Wind screened-icing. Not to be used in place of ethanol as a compass fluid in U.K. compasses.

Alternatives:

Standardised product

U.S. MIL–A–6091A (ASG) Am. 1

Acceptable product

Candaian 3–GP–525a (isopropanol)

Stores Numbers:

Nato Code No.	*Joint Service Catalogue No.*	*Package*	*Navy*	*Army*	*R.A.F.*
S–738	6850–99–910–0475	5 gal	34B/9100475	AAC	34B/9100475

AL-15

Specification: D.T.D. 900/4310.

Composition: Proprietary.

Use: For the removal of hoar frost from transparent panels of parked aircraft

Stores Numbers:

Nato Code No.	*Joint Serivce Catalogue No.*	*Package*	*Navy*	*Army*	*R.A.F.*
—	6850–99–910–5064	5 gal	34B/9105064	AAC	34B/9105064

AL-16

Specification: D.T.D. 900/4351.

Composition: Proprietary.

Uses: For the removal of frozen snow and ice from parked aircraft at very low temperatures.

Alternatives:

Standardised products

U.S. MIL–A–8243A (USAF) Am. 1

Canadian do.

Stores Numbers:

Nato Code No.	*Joint Service Catalogue No.*	*Package*	*Navy*	*Army*	*R.A.F.*
S–742	8650–99–910–5065	5 gal	34B/9105065	—	34B/9105065

AL-9

Specification: D. ENG. R.D. 2491 (Includes AL-10, 19, 24 and 28).

Composition: Methanol (methyl alcohol).

Characteristics: Identical with AL–14 (specification B.S. 506) except for an additional copper strip corrosion limit.

Use: Blended with water to make AL–10, 19, 24 and 28. The water component of the above fluids is required by specification D. ENG. R.D. 2491 to be of very high purity and must not contain more than 15 parts per million of solids, dried at 105°C. Water of this purity is used alone as a power augmentation fluid in Proteus 255 engines in Britannia C aircraft.

Alternatives:

Standardised products

U.S. O–M–232b Grade A
Canadian do.

Stores Numbers:

Nato Code No.	*Joint Service Catalogue No.*	*Package*	*Navy*	*Army*	*R.A.F.*
S–747	6850–99–910–0476	40/45 gal	—	—	34B/9100476

AL-10

Specification: D.ENG. R.D. 2491. (Includes AL-9, 19, 24 and 28).

Composition:

Methanol (AL–9) ... ... 60% by vol.
Water ... ... 40% „ „
plus 1% anti-corrosion oil ZX–15.

Uses: Power augmentation in certain aircraft piston engines i.e. Centaurus 173 engines in Beverley Mk. 1 aircraft and Griffon 57 and 57A engines in Shackleton Mks. 1, 2 and 3 aircraft.

Stores Numbers:

Nato Code No.	*Joint Service Catalogue No.*	*Package*	*Navy*	*Army*	*R.A.F.*
—	6850–99–910–0477	40/45 gal	—	—	34B/9100477

AL-19

Specifications: D.ENG. R.D. 2491. (Includes AL-9, 10, 24 and 28).

Composition:

Methanol (AL–9)	30% by vol.
Water	70% „ „

Use: Power augmentation in turbine engine Avon Mk. 205 in Valiant aircraft.

Stores Numbers:

Nato Code No.	*Joint Service Catalogue No.*	*Package*	*Navy*	*Army*	*R.A.F.*
	6850–99–943–2468	40/50 gal	—	—	34B/9432468

AL-24

Specification: D.ENG. R.D. 2491. (Includes AL–9, 10, 19 and 28).

Composition:

Methanol (AL–9)	60% by vol.
Water	40% „ „

It is the same as AL–10 except that it contains no anti-corrosion oil (ZX–15).

Use: In flight trials in Centaurus 173 and Griffon 57 and 57A engines with the object of replacing AL–10.

Stores Numbers:

Nato Code No.	*Joint Service Catalogue No.*	*Package*	*Navy*	*Army*	*R.A.F.*
—	6850–99–944–0428	40/50 gal	—	—	34B/9440428

AL-28

Specification: D.ENG. R.D. 2491. (Includes AL–9, 10, 19 and 24).

Composition:

Methanol (AL–9)	43·8% by vol.
Water	56·2% „ „

Use: Power augmentation in Dart turbine engines in Argosy C Mk. 1 aircraft.

Stores Numbers:

Nato Code No.	*Joint Service Catalogue No.*	*Package*	*Navy*	*Army*	*R.A.F.*
—	6850–99–220–2292	40/50 gal	—	—	34B/2202292

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4050	AL–7	De-icing Fluid H.63A	T.K.S. (Aircraft De-icing)
4081	OF–4	Lockheed No. 22 Fluid	Lockheed Hydraulic Brake Co. Ltd.
4205	OM–12	Aeroshell Fluid 3	Shell-Mex and B.P. Ltd.
4222	XG–265	Aero Shell Grease 12	Shell-Mex and B.P. Ltd.
4298	XG–250	Compound MS. 4	Midland Silicones Ltd.
4309	XG–344	Esso Aviation Grease AA.	Esso Petroleum Co. Ltd.
4310	AL–15	Kilfrost Fluid P.11	Kilfrost Manufacturing Co. Ltd.
4351	AL–16	Kilfrost Arctic Fluid	Kilfrost Manufacturing Co. Ltd.
4361	OM–3	Aviation Fluid 694	Esso Petroleum Co. Ltd.
4386	OX–16	Arlcone Fluid	Dowty Equipment Ltd.
4402	ZX–26	Grease S.4519	Shell-Mex and B.P. Ltd.
4408	XG–273	Grease S.3074	Shell-Mex and B.P. Ltd.
4420	XG–276	Grease S.4303	Shell-Mex and B.P. Ltd.
4422	ZX–14	Aero Shell Grease 12	Shell-Mex and B.P. Ltd.
4439	XG–276	Molydest Grease	Rocol Ltd.
4513	OEP–740	Spirax 140 E.P. Oil	Shell-Mex and B.P. Ltd.
4609	XG–284	Aero Shell Grease 14	Shell-Mex and B.P. Ltd.
4639	ZX–30	DAG Dispersion 580	Acheson Colloids Ltd.
4643	OEP–30	B.P. Aero Special Oil 1	Shell-Mex and B.P. Ltd.
4651	XG–460	Gredag Grease ZE.	Acheson Colloids Ltd.
4662	XG–261	Silicone Grease MS.44	Midland Silicones Ltd.
4667	XG–266	Moly Grease 8260	Rocol Ltd.
4671	ZX–32	DAG Dispersion 517	Acheson Colloids Ltd.
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Viscosity/Temperature Charts

NOTE

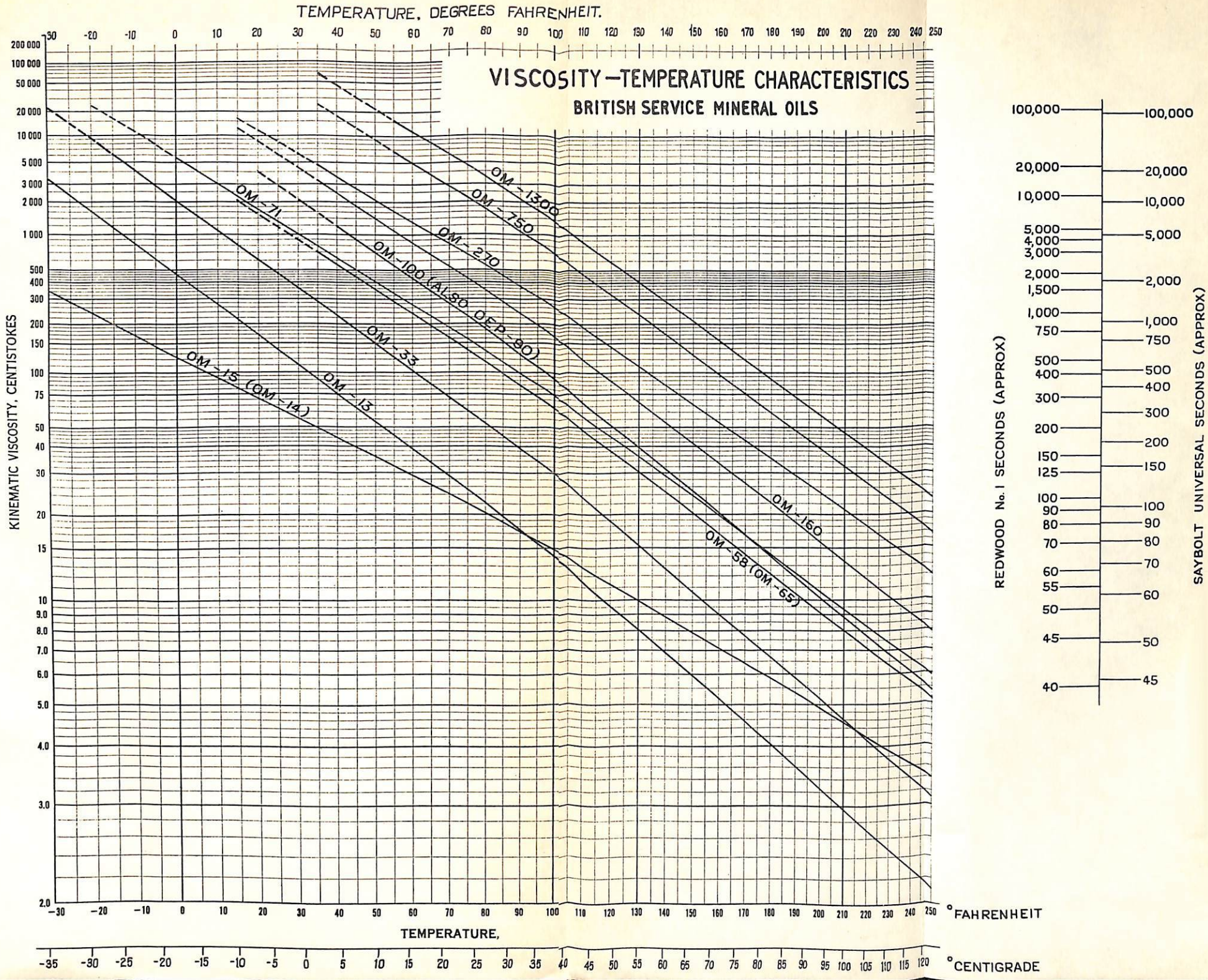
These charts indicate the approximate viscosity of Service oils over a range of temperatures. In general mean viscosity values and steepest curves have been plotted. The full range of viscosity permitted for each grade can be obtained by reference to the text of the handbook.

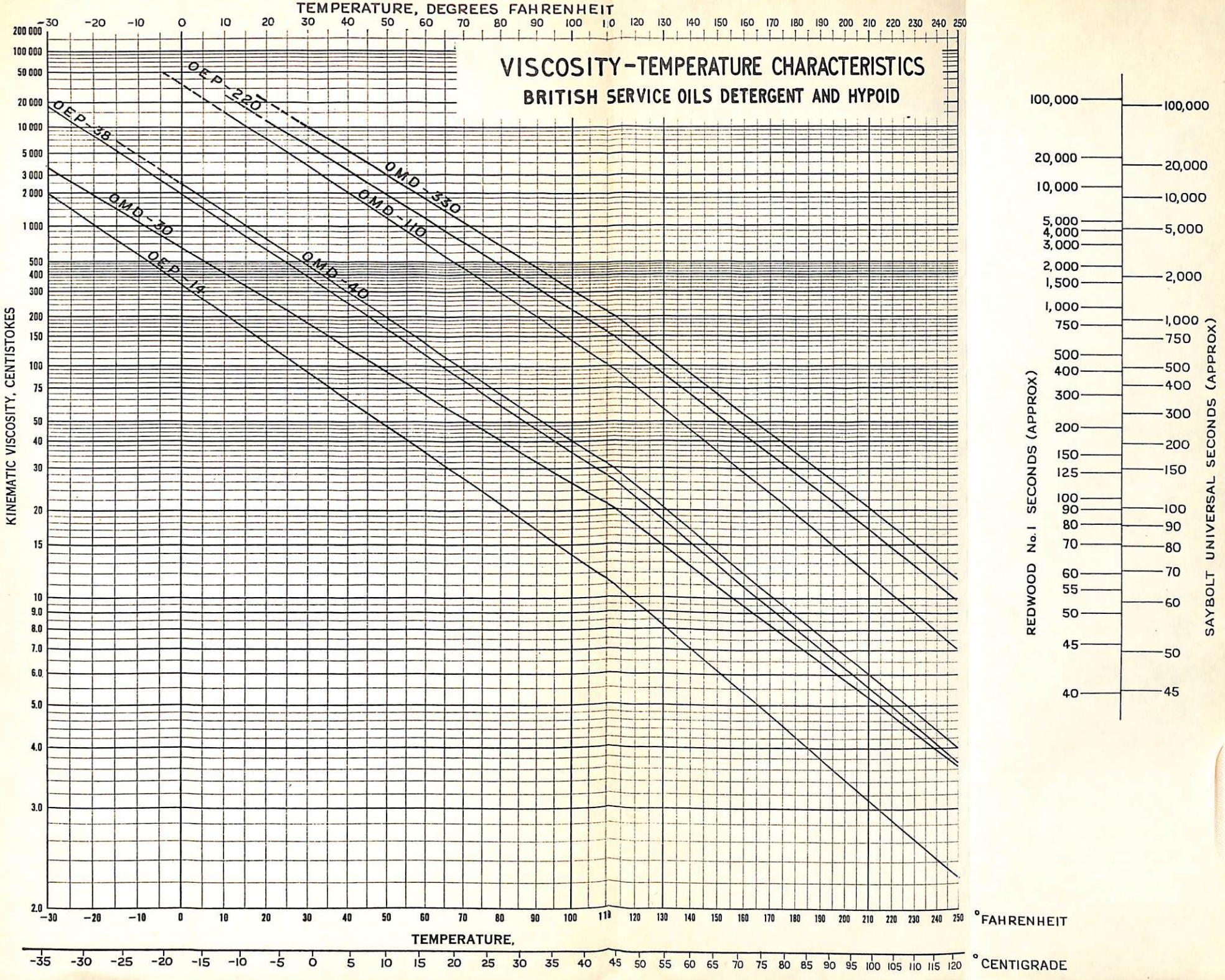
Curves end at the specified cold test temperatures where possible and broken lines indicate the approach of the pour point.

It should be realised that these charts are approximate and the degree of approximation depends on how closely the viscosity limits are fixed by specification and how far the temperature departs from that at which the specification limits are given.

Printed in England under the authority of Her Majesty's Stationery Office
by Jordison & Co. Ltd., London & Middlesbrough

Wt. 2301/9531. K52. 10-62. J. & Co. Ltd. 418.


TEMPERATURE, DEGREES FAHRENHEIT.
VISCOSITY—TEMPERATURE CHARACTERISTICS
BRITISH SERVICE MINERAL OILS
KINEMATIC VISCOSITY, CENTISTOKES
OM-1300
OM-750
OM-270
OM-100 (AI-80 DEP-80)
OM-71
OM-33
OM-15 (OM-14)
OM-13
OM-160
OM-58 (OM-65)
TEMPERATURE,
°FAHRENHEIT
°CENTIGRADE
REDWOOD No. 1 SECONDS (APPROX)
SAYBOLT UNIVERSAL SECONDS (APPROX)


VISCOSITY-TEMPERATURE CHARACTERISTICS
BRITISH SERVICE OILS DETERGENT AND HYPOID
TEMPERATURE, DEGREES FAHRENHEIT
KINEMATIC VISCOSITY, CENTISTOKES
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OEP-38
OMD-330
OMD-110
OMD-30
OMD-40
OEP-14
TEMPERATURE,
°FAHRENHEIT
°CENTIGRADE
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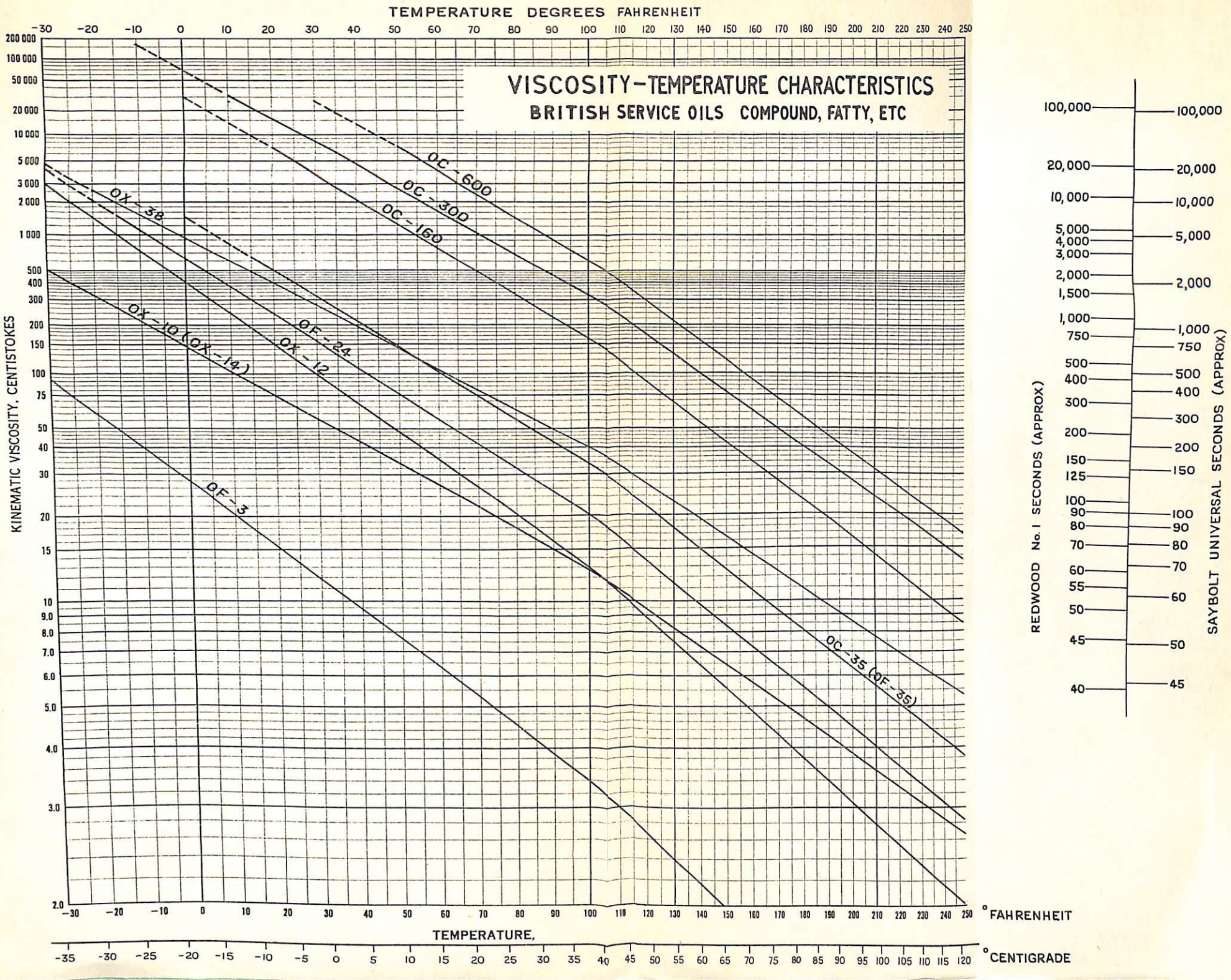
TEMPERATURE DEGREES FAHRENHEIT
VISCOSITY-TEMPERATURE CHARACTERISTICS
BRITISH SERVICE OILS COMPOUND, FATTY, ETC
KINEMATIC VISCOSITY, CENTISTOKES
OC-600
OC-300
OC-160
OX-38
OF-24
OX-12
OX-10 (OX-14)
OF-3
OC-35 (OF-35)
REDWOOD No. 1 SECONDS (APPROX)
SAYBOLT UNIVERSAL SECONDS (APPROX)
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